USE OF ENDOVASCULAR STENT GRAFTS IN THORACOABDOMINAL AORTIC ANEURYSMS

Mehmet Ates[1], Paulo R. L. Prates[2], Scott A. LeMaire[2], Joseph S. Coselli[2]

Siyami Ersek Thoracic and Cardiovascular Surgery Center, The Division of Cardiothoracic Surgery[1], İstanbul, Turkey, The Texas Heart Institute at St. Luke's Episcopal Hospital, and The Division of Cardiothoracic Surgery[2], Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, Texas, USA

Thoracoabdominal aortic aneurysms (TAAAs) involve one or more segments of the aorta from the left subclavian artery down to the inguinal bifurcation. Most TAAAs are caused by age-related degenerative processes that weaken the aorta and usually remain asymptomatic for long periods until they finally produce symptoms. Endovascular stent grafting has been used successfully to treat TAAAs in recent years. The procedure should improve as its use spreads and as the complication rate is reduced. Clinical trials will be needed to compare endovascular stent graft repair with surgical treatment for TAAAs in terms of safety, efficacy, and clinical applicability.

Key words: Thoracoabdominal aortic aneurysms, Endovascular stent grafts, Open surgical repair

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INTRODUCTION

Thoracoabdominal aortic aneurysms (TAAAs) are aneurysms that involve one or more segments of the aorta from the left subclavian artery down to the inguinal bifurcation. Most TAAAs are caused by age-related degenerative processes that weaken the aorta; other frequent causes are dissection, Marfan syndrome, Ehlers-Danlos syndrome, and mycotic infection (1). These aneurysms often occur in high-risk elderly individuals with serious comorbidities such as renal insufficiency, congestive heart disease, hypertension, chronic obstructive lung disease, and diabetes (1,2). TAAAs usually remain asymptomatic for long periods until they finally produce symptoms (most frequently, back pain) prior to rupture.

Open Surgical Repair

The established standard of care for TAAAs is open surgical repair. The first successful surgical treatment of a TAAA was performed by Etheredge in 1955 (3). Subsequent improvements in surgical and anesthetic techniques have made open surgical repair of TAAAs safer and more effective. Judicious use of hypothermia and cerebrospinal fluid drainage has led to reductions in paraplegia (1,4). Nevertheless, surgical treatment continues to be associated with a significant risk of paraplegia, paraparesis, renal failure, and death, especially in older, sicker patients who may not tolerate well the extensive surgical procedures that are often required (1,2,4-8).

Endovascular Stent Graft Repair

In the last decade, endovascular stent graft repair has emerged as a less invasive and potentially less risky alternative. Endovascular stent grafting was first applied clinically to the abdominal aortic aneurysm (AAA) by Parodi and colleagues in 1991 (9) and to the thoracic aortic aneurysm by Dake and colleagues in 1994 (10). Transluminal placement of an endovascular stent is a successful alternative to the treatment of aortic aneurysm. Since then, endovascular stent grafting techniques have been improved

Correspondence: *Mehmet Ates MD*
Sairarsi Cad. Emincinarpasa Sok. No:6/24 Goztepe/ Kadıköy, İstanbul
Tel: 902163600272, Fax: 902163379719
E-mail: drmates@yahoo.com

and in some cases applied to the treatment of TAAAs. Endovascular repair of AAAs requires adequate iliac/femoral access and stent graft attachment zones proximal and distal to the aneurysm that are at least 2 cm long and less than 38 mm in diameter (1). Recently, stent graft attachment zones of proximal and distal aneurysm have been dropped down to 0.5 cm. It also requires close cooperation between surgeons, interventional cardiologists, and radiologists. The extent of disease, feasibility of treatment, and sizing of stent grafts are determined preoperatively using diagnostic techniques such as chest radiography, catheter-based angiography, spiral computed tomography, magnetic resonance imaging, transesophageal echocardiography (TEE), and intravascular ultrasound (IVUS) (2). Intraoperatively, TEE, fluoroscopy, angiography, and IVUS are used to guide stent graft placement (2,11-13). Theoretically, stent grafts can be moved to the site of aneurysms without the need for extensive incisions or aortic cross-clamping. This can result in shorter operative times, less operative blood loss, fewer pulmonary and respiratory complications, and shorter hospital stays (2).

Technical Challenges

A challenge in endovascular stent graft repair is adequate coverage of long aneurysms. Exclusion of extensive TAAAs (e.g., Crawford type I and II) may require staged repair and multiple stent grafts. Palma et al. successfully used multiple polyester-coated stainless steel stents to repair a TAAA involving the thoracic aorta above and the distal abdominal aorta below a normally sized aortic segment between the celiac axis and renal arteries (14). The thoracic aneurysm was repaired first; the abdominal aorta was repaired 2 weeks later with a bifurcated iliac stent graft.

Another challenge is revascularization of involved visceral and intercostal vessels. Combination open surgical and endovascular repair has been successfully used to revascularize visceral arteries. In a patient with a severely calcified aneurysm and pleural adhesions, Iguro and colleagues first grafted the right iliac artery to the superior mesenteric artery, placed a saphenous vein bypass graft between the left iliac artery and the common hepatic artery, and anastomosed a 10-mm prosthetic graft between the left common iliac artery bypass graft and the right common iliac artery before deploying 3 stent grafts through the 10-mm prosthetic graft via the femoral artery (15). In a small case series of patients with high-risk Crawford type IV or pararenal aneurysms, Fulton et al. performed open reconstruction of the renal, mesenteric, or celiac artery to lengthen the proximal neck before excluding the aneurysm with a stent graft via the femoral artery (6). Only 1 of the 10 patients required treatment for an endoleak. In another small case series, Flye et al. (16) successfully treated TAAAs in 3 patients by retrograde revascularization of visceral vessels followed by endovascular exclusion with modular stent grafts. Endoleaks occurred in 2 of these cases and were corrected. In the other case, the first 2 of 7 modular stent graft components were deployed with difficulty in or near the aortic arch but did not result in endoleak. Agostinelli et al. (17) anastomosed an obstructed celiac artery to the superior mesenteric artery to create a landing zone for an endovascular stent graft during combined surgical and endovascular repair. Revascularization of visceral vessels with branched or fenestrated stent grafts has also been reported (18). Chuter and associates successfully excluded a type III TAAA using a multibranched stent graft with outflow into the visceral, renal, and iliac arteries (5).

Intercostal vessel revascularization has been much less successful. A strategy to preserve the intercostal arteries was not reported. Exclusion of intercostal arteries, especially in the descending thoracic aorta, can increase the risk of spinal cord ischemia and the prevention of paraplegia still a limitation (19).

Other challenges arise from stent grafts themselves. Although current stent grafts are more flexible and have lower profiles than their predecessors, they may still become deformed, fail, or detach especially in acutely angled or tortuous segments of the aorta. Endoleaks, in which blood is no longer excluded from the aneurysm sac, may occur (2). In one single-center experience, the endoleak rate after endovascular stent graft repair of descending thoracic aortic aneurysms was 20.3% (15/74) (12). Stents may come loose at distal points of attachment and migrate, especially in the case of large TAAAs immediately above the celiac trunk (7). Stents may perforate the aorta. Reoperation including open repair may be required after endovascular stent graft placement to repair endoleaks, replace damaged stent grafts, or ensure attachment and fixation (20).

Future Directions and Potential Clinical Applications

Despite its limitations, endovascular stent grafting has been used successfully to treat TAAAs. The procedure should improve as its use spreads and as the complication rate is reduced. Improvements in stent technology will likely prevent endoleaks. Clinical trials will be needed to compare endovascular stent graft repair with surgical treatment for TAAAs in terms of safety, efficacy, and clinical applicability. Until then, patients with TAAAs should be carefully selected for endovascular stent grafting and should be closely followed throughout the entire postoperative period (1,4).

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