

Endovascular Treatment of Thoracic Aortic Pathologies in Patients with Aortoiliac Occlusive Disease

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ABSTRACT

Today, with the increasing experience and advances in graft technology, endovascular grafting is applied nearly to all levels of the aorta for the treatment of various aortic pathologies. The major route of the stent graft deployment is from the femoral region through the iliac arteries. Since both aneurysms and arterial occlusive diseases share atherosclerosis as the common ancestor of etiology, some patients may possess both aneurysms and stenosis together. These stenotic changes occurring in the iliac and femoral arteries may complicate the passage of the stent graft system. In this report, we sought to evaluate an alternative novel route of graft system application for endovascular treatment of thoracic aortic aneurysms.

INTRODUCTION

Since the first application of endovascular grafts to the abdominal aortic aneurysms in the early 1990s [Parodi 1991], their usage has expanded to nearly all levels of the aorta [Alpagut 2006]. In recent years, with increasing experience and technological advances, they are frequently used in the treatment of aortic pathologies such as aneurysms, pseudoaneurysms, dissections, stenosis, penetrating ulcers, and rarely various other pathologies such as patent ductus arteriosus (PDA), arteriovenous fistula, etc with high success rates.

Atherosclerosis plays a common role in the etiology of both aneurysms and arterial occlusions [Zarins 2000]. Thus, patients with aortic aneurysms frequently possess different degrees of stenoses at different levels in the aorta and/or its branches [Bickerstaff 1982]. These stenoses have a potential to prevent or complicate endovascular graft treatment because the endovascular graft system requires a suitable diameter vessel for deployment. Generally, the system is deployed from the femoral region through the iliac arteries.

Hence, in the presence of iliofemoral stenosis an alternative route is required for the passage of the endovascular graft system, otherwise treatment of the pathology by surgical means would be necessary, which may sometimes have increased mortality and morbidity rates when compared with endovascular grafting [Moreno-Cabral 1984; Svensson 1993].

Until now, such an alternative route has not been defined in the literature and in this manuscript we sought to present our experience with thoracic aorta endovascular stent graft application through preparatory treatment procedures of the present iliofemoral stenoses.

PATIENTS AND METHODS

Between 2004 and 2006, 26 patients with aortic and iliac pathologies underwent endovascular treatment. There was a patient with PDA. Other diagnoses were aortic arch aneurysms (two patients), descending aorta aneurysms (4 patients, one ruptured), acute type B dissections (3 patients), chronic type B dissecting aneurysms (one patient), abdominal aorta and/or iliac artery aneurysms (16 patients), and iliac artery aneurysms (one patient). Among the patients including the PDA case, 4 patients had aortoiliac and/or iliofemoral occlusive disease and required an alternative route for endovascular graft deployment.

Patient 1

A 27-year-old female patient was diagnosed with PDA with bidirectional flow and with a Qp/Qs value of 1.8 detected by echocardiography. Pathology was further investigated and confirmed with magnetic resonance angiography. The patient was considered for endovascular treatment of the PDA by covering the aortic orifice of the ductus arteriosus.

Under spinal epidural and local anesthesia, the right femoral artery was surgically accessed. However, the diameter of the common femoral artery was found to be about 4 to 5 mm, which would not enable the passage of the endovascular graft system. Angiography of the abdominal aorta, both iliac vessels, and contralateral femoral artery was performed. The whole arterial tree was of small caliber (diameter of the abdominal aorta and both iliac vessels were about 8 mm and 5 mm, respectively). Thus, the procedure was finished and patient considered for surgical treatment of the PDA.

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Patient 2

The patient was a 39-year-old man who presented with acute onset back pain. He was one of our patients who had been treated with endovascular grafting for the mycotic saccular aneurysm at the distal aortic arch one year ago [Alpagut 2006] and was on our routine follow-up program. His symptoms were investigated with thoracoabdominal and aortoperipheral magnetic resonance angiography and it revealed a rupture of the descending aortic aneurysm and right-sided long segment iliofemoral stenosis at the site of his previous endovascular treatment.

Ilioferomal reconstruction and endovascular treatment of the ruptured aneurysm in the same session was planned. Under spinal epidural and local anesthesia, the redo right ilioferomal region was surgically accessed. A 10-mm polytetrafluoroethylene (ePTFE) graft was interposed between the right external iliac artery and superficial femoral artery. A longitudinal arteriotomy was performed to the right side of the graft. The 24 F delivery system (Talent Thoracic Stent Graft, Medtronic AVE, Coil Track TDS; Medtronic, Minneapolis, MN, USA) was inserted through the longitudinal incision on graft and positioned at the descending aorta with fluoroscopic guidance. The graft was expanded and the ruptured aneurysm was excluded. Control angiography demonstrated successful aneurysm exclusion. The procedure was finished following implantation of the deep femoral artery to the graft.

Patient 3

The patient was a 78-year-old man who presented with complaints of back pain. He was one of our patients who underwent aortobifemoral bypass operation in 2001 for abdominal aortic aneurysm. Thoracoabdominal computed tomography angiography was fashioned and it revealed a descending aortic aneurysm with an aneurysm diameter of 6.5 cm. Endovascular treatment of the pathology was selected.

Under spinal epidural and local anesthesia, the right femoral branch of the graft was surgically accessed and the endovascular graft system (Talent Thoracic Stent Graft, Medtronic AVE, Coil Track TDS; Medtronic) was deployed through the longitudinal incision on the graft and positioned at the descending aorta with fluoroscopic guidance, then expanded to exclude the aneurysm. The incision on the graft was repaired with a Dacron patch to minimize stenosis risk.

Patient 4

A 58-year-old male patient was referred with the diagnosis of descending aortic aneurysm from a private clinic where he had undergone left ventricular aneurysmectomy and quadruple coronary artery bypass grafting with saphenous vein grafts. Overall diagnostic work-up of the patient indicated descending aortic aneurysm (descending aorta diameter of 7 cm), increased diameter of the abdominal aorta (infrarenal abdominal aorta diameter of 4 cm), occlusion of the right common iliac artery and superficial femoral artery, and stenosis at the contralateral iliac artery (Figure 1). The treatment strategy for the patient was surgical treatment of iliac lesions and abdominal aorta by an at least 18 × 9-mm bifurcated

graft and superficial femoral artery occlusion by femoropopliteal bypass; then endovascular grafting of the descending aortic aneurysm through the aortobifemoral bypass graft would be performed.

Under general anesthesia, the operation was started with midline laparotomy and bilateral femoral and above the knee incisions. The aortobifemoral bypass operation was performed with a knitted 20 × 10-mm bifurcated graft (end-to-end anastomosis to the infrarenal abdominal aorta and end-to-side anastomosis to both common femoral arteries), and with an 8-mm ringed ePTFE graft right above the knee femoropopliteal bypass operation was performed. A longitudinal incision to the left branch of the aortobifemoral bypass graft was performed and an endovascular graft system (Talent Thoracic Stent Graft, Medtronic AVE, Coil Track TDS; Medtronic) was deployed through the graft and positioned at the descending aorta to exclude the aneurysm (Figure 2). The incision on the graft was repaired primarily.

All the patients, whether treated or not treated, tolerated the procedures safely and were discharged from the hospital in 10 days postoperatively. Control computed tomography angiographies of the treated patients showed successful exclusion of the aneurysms without endoleak and uncomplicated surgical procedures.

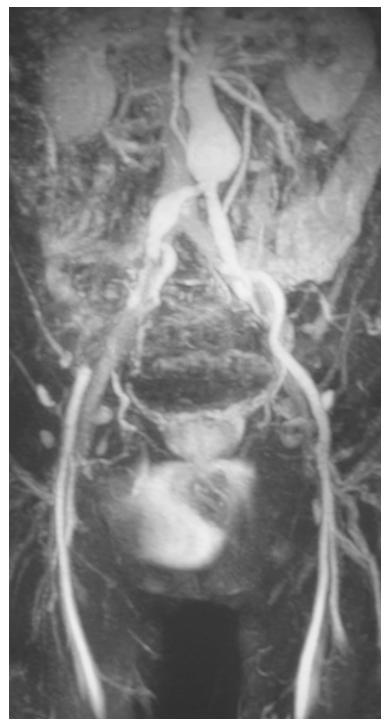


Figure 1. Magnetic resonance angiography showing infrarenal abdominal aortic aneurysm, right iliac artery occlusion, left iliac artery stenosis, and distal right superficial femoral artery stenosis.

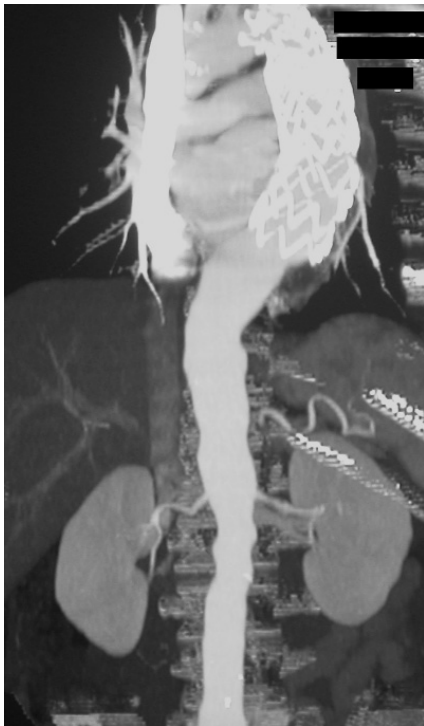


Figure 2. Aortobifemoral bypass operation was performed with a knitted 20×10 -mm bifurcated graft (end-to-end anastomosis to the infrarenal abdominal aorta and end-to-side anastomosis to both common femoral arteries) and the endovascular stent graft system was deployed from the left branch of the aortobifemoral bypass graft and positioned at the descending aorta to exclude the aneurysm.

DISCUSSION

Aneurysms of the thoracic aorta are life-threatening pathologies and have always been a challenge for cardiovascular surgeons. Despite advances in surgical techniques, perioperative anesthesiologic and postoperative reanimation care facilities, traditional surgical treatment of the pathology, ie, prosthetic graft replacement of the descending aorta, still carries considerable mortality (5%-20% in different series) [Estrera 2005] and morbidity rates (being of the most debilitating: paraplegia, visceral organ failure, prolonged mechanical ventilation) [Coselli 2004]. These high mortality and morbidity rates of surgical treatment of thoracic aortic aneurysms have always directed surgeons to search for alternative treatment modalities [Herold 2002; Umana 2002; Lamme 2003; Brandt 2005].

Since the first application of endovascular grafts by Parodi et al in 1991 for the treatment of abdominal aortic aneurysms, and not very long after Parodi, in 1994 by Dake et al, to the thoracic aorta for the management of descending aortic aneurysms, endovascular grafts have become an alternative to the classical conventional surgical treatment of different aortic pathologies especially aneurysms, pseudoaneurysms, dissections, ruptures, stenosis, various fistulae, and penetrating

ulcers. At first, when the mid- and long-term results were not sufficient, the grafts were especially preferred for those patients for whom conventional surgical methods threatened high mortality and morbidity rates and sometimes they were indicated for the ease of the procedure. Nowadays, with the increasing experience and refinements in the graft technology, endovascular procedures are on the way to aid classical surgical methods, and they are frequently performed for the treatment of aortic pathologies including the critical segments of the aorta, such as thoracic and arch levels, with reduced morbidity and mortality rates when compared with open surgery and with excellent early- and mid-term results [Lambrechts 2003; Peterson 2005; Alpagut 2006]. Additionally, endovascular grafting is an alternative to classical open surgery due to its minimally invasive nature and lower stress and lower complication rates than surgical treatment [Alpagut 2006].

The thoracic endovascular graft system is designed usually as a symmetrical ePTFE tube reinforced with ePTFE/fluorinated ethylene propylene (FEP) film and an external nickel-titanium (nitinol) self-expanding stent along the entire surface of the graft. The stent is attached to the graft with ePTFE/FEP bonding tape. A circumferential ePTFE sealing cuff is located on the external surface of the endograft at the base of each flared, scalloped end. Flares are designed to help with conforming to tortuous anatomy. Each cuff is circumferentially attached on one edge with FEP, thus allowing the other end to remain free to enhance sealing of the endoprosthesis to the aortic wall and help eliminate endoleaks [Cho 2006]. The system itself, even though when it is packed and ready for use constitutes a significant diameter, attenuates its application through any artery and requires a suitable diameter arterial route for deployment. The femoral artery is the most commonly accessed vessel for this purpose.

Atherosclerosis is one of the common ancestors in the etiology of aneurysms and stenosis formation in the arterial tree [Bickerstaff 1982; Zarins 2000]. Thus, both of the pathologies such as a thoracic and/or an abdominal aortic aneurysm together with iliofemoral stenosis may frequently coexist in the same patient, which may further complicate endovascular management of the aneurysms, and being more critical, the descending aortic aneurysms. In such cases, other than the transfemoral route, for larger vessels such as iliac arteries or the aorta itself either the antegrade or retrograde route can be used for the deployment of the endovascular graft; otherwise surgical treatment with all its risks, is inevitable. Additionally, an alternative strategy combining both endovascular treatment and reconstruction of the stenotic arterial segment has not been defined, in the literature especially for the patients possessing a descending aortic aneurysm and iliofemoral occlusive disease.

As an alternative to native vessels for the passage of the endovascular graft system, prior reconstruction of the stenotic segments with appropriately sized prosthetic graft materials that can allow for the deployment of the packed endovascular graft system and then the conductance of the endovascular graft treatment by the way of these prosthetic

materials seems to be a feasible option. Our series included relatively high-risk patients for conventional open surgical treatment methods and treatment of their thoracic aneurysms was performed by endovascular grafting. However, the complete arterial tree was in decreased calibers in the PDA case and endovascular treatment was not applicable even through any prosthetic material that could be anastomosed directly to the aorta itself.

In conclusion, endovascular stent-graft placement has developed a safe and effective treatment for various diseases of the descending aorta. Endovascular graft implantation to the descending aortic pathologies through reconstruction grafts used for the treatment of stenotic segments of the lower levels of the arterial tree is a feasible and attractive alternative route for endovascular graft deployment in patients possessing aortoiliac or iliofemoral occlusions.

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