Endoluminal stent grafting of the descending thoracic aorta

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Background. **The timing and optimal therapy for descending thoracic aortic diseases still remain a challenging problem for surgeons. Nowadays endovascular treatment is becoming more and more popular both for acute as well as chronic cases. This technique is more respectful of the tissue integrity and avoids major and demolitive surgery for the patient.**

Methods. **In 1 year 32 patients presenting with descending thoracic aorta dissection (n = 25) or with descending thoracic aorta aneurysms (n = 7) were submitted to an endovascular procedure using covered stents. Ten of them were operated upon in general anesthesia whereas in 22 spinal anesthesia was administered. In neither group did anesthesia-related complications occur.**

Results. **In all cases in which endovascular treatment was possible, an endovascular stent was used for the treatment of the descending thoracic aorta disease. Only 1 patient had a major complication, which was a retrograde dissection of the ascending aorta surgically treated in an emergency setting. Our policy is to treat uncomplicated type B dissections in the subacute phase after 1 week of antihypertensive pharmacological treatment, but within 1 month of onset. Our mid-term follow-up shows very good results with no mortality and no stent-related complications.**

Conclusions. **Stent grafting is replacing conventional surgery for descending thoracic aorta aneurysms and dissections. Our results suggest that in case of dissections, endovascular treatment should be delayed until the subacute phase, in the absence of complications. The risks and mortality are decreased.**

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In spite of significant improvements, thoracic aorta diseases such as aneurysms and acute and chronic type B aortic dissection still constitute life-threatening conditions.

Different therapies are nowadays available, but which is the best one and the exact timing for the optimal management of these pathologies are still controversial issues which constitute a challenge for surgeons. Surgical repair with graft interposition has been the traditional therapy for patients with descending aorta aneurysms. Nevertheless, despite technical advances, the reported operative mortality is still substantial and ranges between 5 and 20% for elective cases, increasing to nearly 50% in patients who necessitate emergency operative treatment. Moreover, in several cases surgery is contraindicated because of the patient's elderly age and the concomitance of associated pathologies (chronic obstructive pulmonary disease, renal failure, cerebrovascular diseases)[1].

Type B aortic dissection also carries a high mortality and about 11% of patients die within the first year. On the other hand, the 5-year survival approximates 80%[2]. Medical therapy with antihypertensive drugs is still the first choice treatment, even though it does not significantly improve the natural history of this condition[1,2]. Surgical treatment in the acute phase is reserved only for patients presenting with abdominal malperfusion, spinal cord ischemia or impending rupture and is associated with a substantial mortality (over 50%) and morbidity.

Following the introduction of the technique in 1991 by Parodi et al.[3] for the treatment of abdominal aortic aneurysm and the experience of Mitchell et al.[4] and Dake et al.[5] the endovascular treatment of thoracic aorta diseases with covered stents has now become a valid alternative to medical and traditional surgical therapy and besides remarkably decreasing the risk, also seems to improve the survival and quality of life of these patients.

We herein report our initial experience and discuss the indications and timing for the endovascular stent graft repair of the descending thoracic aorta.

Methods

Between January 2000 and February 2001, 32 patients (22 males, 10 females, mean age 62 ± 9 years, range 48 to 82 years) underwent transluminal endovascular stent graft repair of the descending thoracic aorta at our department. Seven patients had a thoracic aortic aneurysm > 6 cm in diameter and 25 had type B dissection, 5 in the acute phase and 20 in the subacute phase (> 2 weeks and < 2 months following the diagnosis). All patients had a history of chronic hypertension and 25 (84%) were obese. No patient had Marfan's syndrome or other collagenopathies, and none had previous cardiac or vascular surgery.

The diagnosis was confirmed in all cases at spiral computed tomography including three-dimensional reconstruction (Fig. 1) and all patients were submitted to digital subtraction angiography (Fig. 2) the day before the procedure. All the procedures were performed in an angiography-suite, with stand-by for cardiopulmonary bypass. The first 10 cases were performed with the patients under general anesthesia, while the remaining 22 patients were submitted to spinal anesthesia.

The vascular access was achieved by means of surgical exposure of the common femoral artery or, if this vessel was too small, the common iliac artery was reached extraperitoneally.

Figure 1. *Three-dimensional reconstruction at computed tomography of aortic type B dissection.*

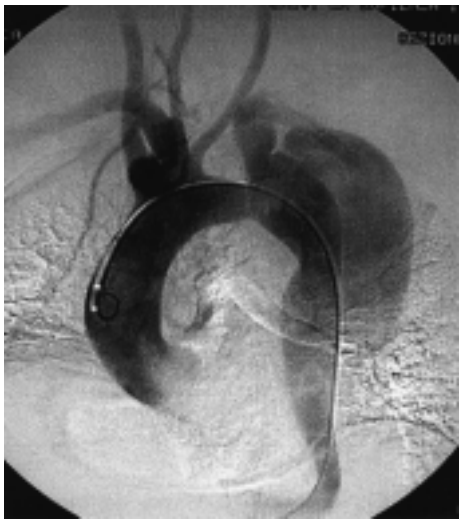

Figure 2. *Angiographic photogram showing aortic type B dissection.*

In all cases we used the Thoracic Excluder (W.C. Gore, Flagstaff, AR, USA), a self-expandable prosthesis with a nitilol endoskeleton covered with woven polyester material (PTFE) mounted on a placement catheter requiring a 24F teflon sheath.

In 1 patient we used 4 prostheses, in 8 patients 3 prostheses, in 20 patients 2 prostheses, and in 3 patients only 1 prosthesis.

The stents had a diameter of 28 mm (n = 2), 30 mm (n = 11), 31 mm (n = 10), 34 mm (n = 40), 37 mm (n = 7), 40 mm (n = 2) and a length of 10 mm (n = 55), 15 mm (n = 18). In all 71 devices were implanted.

Two patients needed an additional covered stent graft in a peripheral site (axillary and common iliac arteries) and 5 patients had renal artery stenting because of renal failure due to renal malperfusion.

Endovascular procedure. All patients were placed in supine decubitus and the invasive blood pressure, electrocardiogram and urine output were monitored. Ten were under general anesthesia and 22 received spinal anesthesia. Among the latter, in only 1 case it was necessary to convert to general anesthesia in a second step.

The femoral artery or, in a few cases, the common iliac artery were surgically exposed.

Through a percutaneous left brachial access in type B dissection or through a percutaneous femoral approach in other cases a pigtail catheter was inserted over a guide wire into the true lumen and intraoperative angiography performed[6].

Through a transverse arteriotomy, Amplatz ultra-stiff (Boston Scientific Corporation, Miami, FL, USA) guides were introduced over 24F sheaths (Cook Inc., Bloomington, IN, USA) and pushed up to the aortic arch.

The stent graft systems were inserted over the guide wire and released in the correct position after angiographic control. In some cases, it was necessary to blow

up the balloon so as to better anchor the prosthesis to the aortic wall[4-7].

After the end of the procedure and angiographic check, the systems and guides were removed, the arteriotomy sutured and the patients transferred to the intensive care unit.

Results

Successful stent deployment was technically achieved in all cases and at a median follow-up of 12 ± 2 months (range 6-18 months) all patients are still alive.

The only major intraoperative complication was a retrograde extension of a type B dissection[8] which needed emergency surgical treatment for the replacement of the ascending aorta with the patient in hypothermic circulatory arrest. The operation was successful but residual dissection of the arch persisted owing to the fact that the stent was so positioned that it faced the arch thus making its removal too difficult and time-consuming. The patient was discharged on the twentieth postoperative day.

There were no epidural anesthesia-related neurological, cardiac or renal complications. In no case did the patient present with paraplegia.

Those patients presenting with a type B dissection were submitted to stent coverage of the subclavian artery owing to the very close proximity of the intimal tear. All these patients are still free from ischemic symptoms of the left arm and no one has required a carotid-subclavian bypass, in spite of a mean gradient in arterial blood pressure between the right and left arms of 50 mmHg.

At computed tomographic scan check (Fig. 3) before discharge, 10 patients had a primary endoleak[9]. Seven of these were treated successfully with balloon blow-up. Three patients were not treated and after 1 month repeat computed tomographic scan showed spontaneous thrombosis.

There were 4 cases of persistent fever without laboratory data of sepsis. The fever receded with antibiotic therapy. In 8 cases, infections of the site of access occurred. Six were superficial and two deep. The latter necessitated surgical toilette.

The mean stay in the intensive care unit was 36 hours and the mean hospital stay was 10 days.

Discussion

In the last decade, the incidence of thoracic aorta diseases seems to have increased probably as a consequence of improvements in diagnostic techniques.

The incidence of type B dissection and thoracic aorta aneurysm is about 10 cases/100 000 person-years each. The natural history of these pathologies without treatment says that the mortality is too high to be acceptable.

Figure 3. *Computed tomographic scan control after endoluminal stent grafting of the thoracic aorta.*

The actuarial survival rate of type B dissection is 91% at 1 month, 89% at 1 year and 80% at 5 years, while the risk of rupture of a descending thoracic aorta aneurysm over 6 cm in diameter is between 49 and 75% at 5 years[1,2,4-6,10].

It is clear that medical therapy alone does not suffice for adequate treatment of these patients; nevertheless, surgery is burdened with high mortality and morbidity rates. In the acute phase, the surgical mortality for type B dissection increases to over 50% while the mortality related to elective surgery for aneurysms or post-dissection dilation ranges between 5 and 20%. These data clarify why even the more aggressive surgeon tries to avoid such high risk surgery unless it is really mandatory.

Moreover, surgery is often contraindicated because of the patients' elderly age and poor general status (cardiac, respiratory and renal failure). Hence, the reason why the endovascular approach to these diseases is becoming more and more popular.

Following the introduction, by Parodi et al.[3] in 1991, of this approach for the treatment of abdominal aortic aneurysms endovascular stent grafting has, since 1992, been extended to the thoracic aorta[4,5]. Although the first devices were custom-made and necessitated balloon dilation[5], self-expandable prostheses[6] of different sizes (up to 40 mm in diameter and over 15 mm in length) and allowing extension of the indications of the procedure are now available.

The stent graft is usually chosen on the basis of the spiral tomography measured diameters and is oversized by about 3-4 mm so as to allow better radial fixing to the aortic wall[6].

Endovascular treatment is not always feasible and in fact nowadays several contraindications are reported: severe aorto-iliac occlusive disease, extreme tortuosity of the thoracic aorta and the absence of a proximal or distal landing zone consisting of at least 1 cm of normal aorta and necessary for safe graft deployment.

However, the use of spinal anesthesia allowing one to perform this procedure even in critical patients, has resulted in an increase in its indications.

In our series of endovascular stent graft repairs for diseases of the descending thoracic aorta we have achieved very good results without any operative or delayed death and with a low complication rate: one case of retrograde extension of the dissection necessitating emergency surgery due to the involvement of the ascending aorta and to the relative risk of intrapericardial rupture.

With regard to our indications, we believe that treatment of thoracic aorta aneurysms exceeding 6 cm in diameter is mandatory. The mid-term follow-up data suggest that endovascular stent grafting is a very good and low risk procedure, in the absence of contraindications. In fact, none of our selected patients had major problems. On the other hand, conventional surgery carries a higher risk. Thoracic aorta aneurysms can be safely treated on an elective basis when their diameter exceeds 6 cm. In our experience, even the hypothetical occlusion of the left subclavian artery by the covering stent has never been a problem. Besides, in view of the fact that the collateral circulation was always sufficient, we never had to perform a bypass on that artery.

With regard to type B dissections, the indication for an interventional procedure depends on complications. Notwithstanding this, we still shifted our first choice treatment from surgery to endovascular repair in all cases[10].

We performed the procedure immediately (acute phase) in case of a complicated dissection associated with visceral malperfusion or impending rupture and between 1 and 4 weeks later (subacute phase) in case of an uncomplicated type B dissection. The aims of this approach are to reduce the short-term mortality that increases to approximately 10% in the first month and to prevent secondary events due to progressive dilation of the false lumen avoiding, if possible, the necessity of proceeding during the first few days when the aortic wall is still fragile and the healing process has not yet resulted in adequate fibrosis or thrombosis.

In summary, on the whole the saying "the sooner the better" regarding the endovascular treatment of descending thoracic aorta diseases does not apply, because we are dealing with different pathologies.

In case of type B aortic dissections we are convinced that 1 week spent in the intensive care unit for blood pressure control allows us a safer and more successful therapy. So far, such a policy has resulted, in the short and medium follow-up, in a better outcome compared to that observed following conventional surgery and medical therapy. A longer follow-up is however necessary in order to exclude that we are creating a new pool of patients carrying a stent. In fact, migration of these prostheses or even delayed rupture of the aortic wall has elsewhere been reported.

For descending thoracic aorta aneurysms we can say "the sooner the better" in case of diameters approaching 6 cm, but of course the indication remains elective, unless rupture is impending.

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