Eight-year follow-up of endovascular repair of a brachiocephalic trunk aneurysm due to Takayasu’s arteritis

Domenico Angiletta, MD, David Marinazzo, MD, Gloria Guido, MD, Martinella Fullone, MD, Raffaele Pulli, MD, and Guido Regina, MD, Bari and Florence, Italy

Aneurysms of the brachiocephalic trunk are rare but their clinical outcomes are potentially devastating; they include rupture, cerebral or arm ischemia secondary to thromboembolism, and compression of the surrounding structures. Although open repair has proven successful, it is associated with significant morbidity and mortality rates. Endovascular treatment, if anatomically feasible, may offer a safer and less invasive approach to these lesions, especially in high-surgical-risk patients. We report the good long-term outcome of endovascular repair of a large innominate artery true aneurysm due to Takayasu’s arteritis. A stent graft was safely and successfully deployed to exclude the aneurysm; assessment by vascular imaging at 8-year follow-up demonstrated the efficacy of the procedure. (J Vasc Surg 2012;56:504-7.)

Innominate artery (IA) aneurysms are rare but potentially severe due to the risk of rupture, embolization, or compression of the adjacent structures. To prevent these complications, surgical repair is recommended even in asymptomatic patients. Although open repair has been shown to be an effective treatment, exposure of the IA is associated with significant morbidity and mortality rates.

Endovascular therapy offers an attractive alternative to surgery and, in recent years, has yielded promising results, although there are still insufficient data in the literature on the long-term outcome. Herein we describe the successful long-term outcome of a stent graft repair of an IA true aneurysm due to Takayasu’s arteritis (TA).

Aneurysmal changes are uncommon in TA and are considered as major complications related to the prognosis of the disease. Treatment of TA-related aneurysms may require a different approach than atherosclerotic ones, because of the multi-arterial involvement, the progressive and relapsing course of the disease, and the greater life expectancy of patients. The surgical treatment should be determined by the location and the extent of aneurysmal lesions as well as the degree of inflammation. Unless a life-threatening condition occurs, controlling vascular inflammation with medical treatment prior to surgery seems to be beneficial, in order to avoid potential surgery-related complications due to active inflammation that could worsen the prognosis of these patients.

CASE REPORT

In 1997, a 16-year-old girl was admitted to our institution with a diagnosis of tight stenosis of the left renal artery and a 2-cm-long occlusion of the right renal artery. The patient was hypertense (200/110 mm Hg) despite treatment. Blood tests revealed a raised (80 mm/h) erythroedsemation rate (ESR), as well as a raised alpha-2-globulin fraction.

First, management was by a successful percutaneous transluminal angioplasty (PTA) of the left renal artery. Then, after an unsuccessful PTA of the right renal artery, an aortorenal saphenous vein bypass graft was performed with complete normalization of the pressure values. Histology confirmed the preoperative hypothesis of TA, and immunosuppressive treatment began.

In 2000, a tight stenosis of the left subclavian artery was diagnosed and successfully treated with PTA. A clinically asymptomatic 20-mm diameter IA aneurysm was also detected. The patient initially refused surgery, so follow-up was recommended.

In the next 2 years, the clinical conditions of the patient were stable, although the ESR remained slightly elevated.

In 2002, during the annual echo-color-Doppler (ECD) control of the supra-aortic trunks, a significant increase in size of the IA aneurysm was diagnosed. Computed tomography angiography (CTA) revealed a 4 × 4-cm fusiform aneurysm of the distal portion of the IA extending to the proximal common carotid artery (CCA). Preoperative angiography confirmed the diagnosis (Fig 1).

The risks and benefits of traditional revascularization vs an endovascular procedure were carefully considered. The suitable anatomical conditions, including adequate 15-mm-long landing zones and absence of tortuosity and mural thrombus of the target vessels, led us to prefer the endovascular approach; also, because the patient refused sternotomy.

The combination of laboratory investigations (ESR and C-reactive protein) together with clinical signs and preoperative CTA findings was employed to assess the status of the disease before the procedure. The patient was in a chronic active subclinical condition. Her systemic clinical signs and laboratory results were normal except for a slightly elevated ESR. Preoperative CTA did not show any mural changes indicative of active lesions of TA.

From the Department of Vascular and Endovascular Surgery, University of Bari, Bari; and Department of Vascular and Endovascular Surgery, University of Florence, Florence.

Author conflict of interest: none.

Reprint requests: Guido Regina, MD, Department of Vascular and Endovascular Surgery, University of Bari, P.zza G. Cesare, 11-70124, Bari, Italy (e-mail: g.regina@chirvasc.uniba.it).

The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

Copyright © 2012 by the Society for Vascular Surgery.

doi:10.1016/j.jvs.2012.02.031
The patient was still on immunosuppressive therapy. The medical treatment was agreed upon with the Internal Medicine Unit and was tailored to the patient according to clinical conditions and laboratory values.

After performing a carotid-subclavian saphenous vein bypass to maintain the vertebral artery flow, via a transcervical approach with surgical exposure of the CCA, a 16- × 14.5- × 100-mm Gore Excluder endoprosthesis (W. L. Gore and Associates, Flagstaff, Ariz) was positioned in the CCA and extended to the distal IA, across the subclavian artery; to exclude the aneurysm, angiographic control was obtained by a percutaneous femoral approach. The patient remained neurologically intact both throughout the procedure and postoperatively, with palpable radial and ulnar arterial pulses.

One year later, ECD and magnetic resonance angiography controls of the supra-aortic trunks showed patency of the endograft with complete exclusion of the aneurysm and asymptomatic occlusion of the carotid-subclavian bypass. Then, the patient was lost to annual follow-up evaluations, until she returned to our institution 7 years after the last follow-up, referring a pulsatile mass on the right side of the neck. The CTA control (Fig 2) revealed a patent and well-positioned stent graft with complete thrombosis of the aneurysmal sac and absence of leakage. The CTA scan also showed a 1.8- × 1.8-cm aneurysm of the right carotid artery bifurcation. However, the patient refused further surgery for this disease, although she has been informed about the risk of aneurysmal-related complications.

FIG. 1. Preoperative angiography showing a large innominate artery aneurysm, with patent carotid and subclavian vessels.

FIG. 2. Three-dimensional reconstruction computed tomography angiography (CTA) scan performed 8 years after surgery demonstrating a patent and well-positioned innominate artery stent graft, with no evidence of endoleak, as well as an aneurysmal dilatation of the right carotid bifurcation.

discussion

Aneurysms of the brachiocephalic trunk are rare, accounting for only 1% to 3%1-3 of all arterial aneurysms. The literature shows that approximately 3% to 8% of all brachiocephalic aneurysms involve the IA.3,4 Moreover, repair of aneurysmal lesions of the IA accounts for only 4% of all IA surgery.5

Clinical manifestations such as distal embolization or thrombosis, rupture, and compression of adjacent structures may occur. Embolism may occur in the right arm and in the brain, resulting in right hemispheric symptoms, amaurosis fugax, or vertebrobasilar syndrome. Compressive symptoms may induce dyspnea, hoarseness or upper compartment edema from compression of the trachea, recurrent laryngeal nerve, and mediastinal veins, respectively.1,4-7 Hemorrhage from spontaneous rupture is a rare but life-threatening condition.4,5,7

An anatomical classification of aneurysms of the IA has been proposed by Kieffer et al7 and includes three groups based on the extent of the aneurysmal disease: group A, quite rare, does not involve the origin of the IA; group B, the most common, involves the origin of the IA but not the aorta; and group C involves both the IA and the ascending aorta. Our patient was affected by a group A aneurysm.
Nowadays, atherosclerosis is the most frequently cited etiology. Mycotic aneurysms, at one time more frequent because of the diffusion of syphilis, have decreased but not completely disappeared. In younger patients, underlying causes include connective tissue disorders such as Marfan or Ehlers–Danlos syndrome and large-vessel vasculitis such as TA. Penetrating and blunt injuries can also lead to pseudoaneurysm formation.

Treatment of TA-induced aneurysms usually requires a different approach than ordinary aneurysms. Aneurysm formation is considered expression of high severity of the disease, leading to a poor long-term prognosis. The inflammatory nature and variable pattern of involvement of the affected vessels makes arterial reconstructions challenging. Thus, it is recommended, unless an emergency condition occurs, that patients with TA undergo surgery at the time of quiescent disease to minimize operative risk and avoid complications due to inflammation, such as restenosis, thrombosis, anastomotic failure, and pseudoaneurysm formation.

Administration of immunosuppressive agents is employed to control inflammatory reaction during the acute phase of the disease and continued on long-term after surgery. When prompt vascular interventions are needed, immunosuppressive treatment should be started perioperatively and continued after the procedure to strictly control the disease activity.

A long-term monitoring of vascular reconstructions is mandatory, especially in patients with active disease at the time of initial operation. Moreover, it must be considered that in TA the lesions occur in younger patients with a longer life expectancy. Therefore, surgical repair is suggested even for small and asymptomatic aneurysms, considering the potential risk of rupture at long-term.

Because of the progressive and relapsing nature of TA, the evolution of the disease is often unpredictable, even when therapy is properly set. Therefore, even after surgical repair, patients with TA should always be considered at risk of new aneurysm development, thus requiring periodic long-term observation and eventual early additional surgery. Treatment options of IA aneurysms include both open surgical repair and endovascular procedures, which are recognized as promising techniques and have become more common in the last decade.

Open surgical repair is the conventional treatment. This is generally performed via a median sternotomy, if necessary, including a cardiopulmonary bypass and induced hypothermia. Although this treatment provides excellent long-term results, significant associated morbidity and mortality rates have been reported in the literature, even in more recent reports.

Endovascular repair provides a minimally invasive technique in high-surgical-risk patients, resulting in minimal blood loss and tissue damage, a shorter operative time, and lower morbidity. Moreover, hospital stay and recovery periods are also shorter, thereby reducing health-care costs. However, both the approach to the vessel and the selection of devices must be carefully considered to avoid serious complications, including arterial laceration and dissection, thromboembolism, graft migration, or thrombosis.

Close follow-up with ECD and CTA is strictly recommended to monitor the integrity of the stent graft and any new stenotic or dilatative lesions arising upstream or downstream of the device. This is even more essential in younger patients affected by TA, who are prone to further manifestations of the disease throughout their life.

Although coverage of the right subclavian artery after stent graft repair of aneurysms involving the distal portion of the IA is usually well tolerated, cerebral and right arm ischemia is a major concern. In our patient a carotid-subclavian bypass was previously performed to prevent these complications.

Several successful endovascular repairs of aortic aneurysms due to TA have been reported. However, to our knowledge, no case of endovascular repair of a brachiocephalic artery aneurysm secondary to TA has yet been published.

Stent graft repair of both true and false IA aneurysms has been reported in the literature as a feasible and effective treatment. However, this approach has been

Table. Endovascular repair of innominate artery aneurysms

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Type</th>
<th>Treatment</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chandler et al15/1999</td>
<td>Post-traumatic pseudoaneurysm (blunt trauma)</td>
<td>Covered Palmaz stent (PTFE)</td>
<td>NA</td>
</tr>
<tr>
<td>Axiota et al16/2000</td>
<td>Post-traumatic pseudoaneurysm (blunt trauma)</td>
<td>Covered Palmaz stent (PTFE)</td>
<td>18 months</td>
</tr>
<tr>
<td>Puech-Leao and Orra16/2001</td>
<td>True aneurysm</td>
<td>Covered Palmaz stent (Dacron)</td>
<td>2 years</td>
</tr>
<tr>
<td>Blattman et al17/2002</td>
<td>Post-traumatic pseudoaneurysm (penetrating trauma)</td>
<td>Stent graft</td>
<td>NA</td>
</tr>
<tr>
<td>Bush et al18/2002</td>
<td>Mycotic pseudoaneurysm</td>
<td>Stent graft</td>
<td>6 months</td>
</tr>
<tr>
<td>Chang et al11/2005</td>
<td>True aneurysm</td>
<td>Stent graft</td>
<td>NA</td>
</tr>
<tr>
<td>Huang and Kao17/2008</td>
<td>Post-traumatic pseudoaneurysm (blunt injury)</td>
<td>Stent graft</td>
<td>1 year</td>
</tr>
<tr>
<td>DuToit et al1/2008</td>
<td>N &amp; pseudoaneurysms; n A-V fistulas</td>
<td>Stent graft</td>
<td>NA</td>
</tr>
<tr>
<td>Ahmed et al20/2009</td>
<td>Iatrogenic pseudoaneurysm (postbiopsy)</td>
<td>Stent graft</td>
<td>NA</td>
</tr>
</tbody>
</table>

A-V, Arteriovenous; NA, not available; PTFE, polytetrafluoroethylene.
mainly described in individual case reports, with limited follow-up periods, varying from a few months to no more than 2 years,\textsuperscript{10} and only few of such reports described cases of true IA aneurysms, while most were cases of post-traumatic pseudoaneurysms (Table).

This report shows that stent graft repair of IA aneurysms, if anatomically feasible, is a safe, effective, and durable option. It also demonstrates a better long-term patency than the carotid-subclavian vein bypass, which was shown to be occluded at the 1-year follow-up. However, results in large series and with longer follow-ups are needed to definitively establish the safety and efficacy of endovascular repair compared with open surgery.

REFERENCES


Submitted Nov 19, 2011; accepted Feb 9, 2012.