The Heart Surgery Forum #2010-1061
13 (6), 2010 [Epub December 2010]
doi: 10.1532/HSF98.20101061

Online address: http://cardenjennings.metapress.com

"Hybrid" Approach for the Treatment of Aortic Arch Aneurysm

Yue Wang,[1] Jian'an Wang,[2] Qicai He,[1] Sanjay Kumar,[3] Ramakanta Panda[3]

[1]Cardiothoracic Surgery Department, Sir Run Run Shaw Hospital of Zhejiang University Medical College, Hangzhou, China; [2]Cardiology Department, Second Affiliated Hospital of Zhejiang University Medical College, Hangzhou, China; [3]Cardiothoracic Surgery Department, Asian Heart Institute and Research Centre, Mumbai, India

ABSTRACT

Background: High mortality and morbidity rates are associated with the conventional surgery for aortic arch aneurysm because of cardiopulmonary bypass and deep hypothermic circulatory arrest. In this report, we describe a "hybrid" treatment for aortic arch aneurysm that combines the surgical debranching procedure and the stenting technique.

Methods: A surgical bypass graft is created from the ascending aorta to every main branch of the aortic arch. Subsequently, an endovascular stent graft is deployed retrogradely through the femoral artery with the aid of digital subtraction angiography.

Result: The patient was discharged on postoperative day 7. A computed tomography scan was routinely performed at 1 week postoperatively to confirm the good patency of all grafts and the stent.

Conclusion: The feasibility and the benefit of the hybrid treatment for aortic arch aneurysm are confirmed.

INTRODUCTION

The conventional surgical therapy for aortic arch aneurysm has high morbidity and mortality because of the use of cardiopulmonary bypass (CPB) and deep hypothermic circulatory arrest; however, only stent graft placement causes neurologic and vascular complications in the repair of aortic arch aneurysms because of the occlusion of the 3 main branches of the aortic arch. The debranching-stent hybrid procedure has been described to have good short-term results for thoracoabdominal aneurysm repair. For aneurysms involving the aortic arch, however, use of the hybrid approach has rarely been reported. In this report, we describe the use of prosthetic grafts for total debranching of the 3 vessels of the aortic arch and placement of an endovascular stent graft (ESG) with the "hybrid" procedure. We describe the technique for one of our patients who received the treatment and showed good short-term follow-up results.

Received April 26, 2010; received in revised form June 23, 2010; accepted July 2, 2010.

Correspondence: Jian'an Wang, Cardiology Department, Second Affiliated Hospital of Zhejiang University Medical College, 88 Jie Fang St, Hangzhou 310009, PR China; +86-13805786328, +86-571-87767113; fax: +86-571-87068001 (e-mail: wang_jian_an@tom.com).

CASE REPORT

A 62-year-old female patient presented with heaviness in the chest, breathlessness, hoarseness of voice, palpitations, and cramps of the hands and legs over a 6-month period. A chest x-ray showed widening of the superior mediastinum and aortic knuckle. A computed tomography scan of the chest with volume-rendered reconstruction showed a large saccular aneurysm arising from the arch of the aorta along its inferolateral wall at the level of the origin of the left subclavian artery (LSA). A large amount of hypodense soft tissue surrounding this aneurysm was noted, with a focal area of peripheral calcification suggestive of pseudoaneurysm with peripheral thrombus (Figure 1). The patient was then treated with the hybrid approach.

In stage 1, a median sternotomy was performed with the patient under general anesthesia. The pericardium was opened, and the ascending aorta was exposed. The innominate

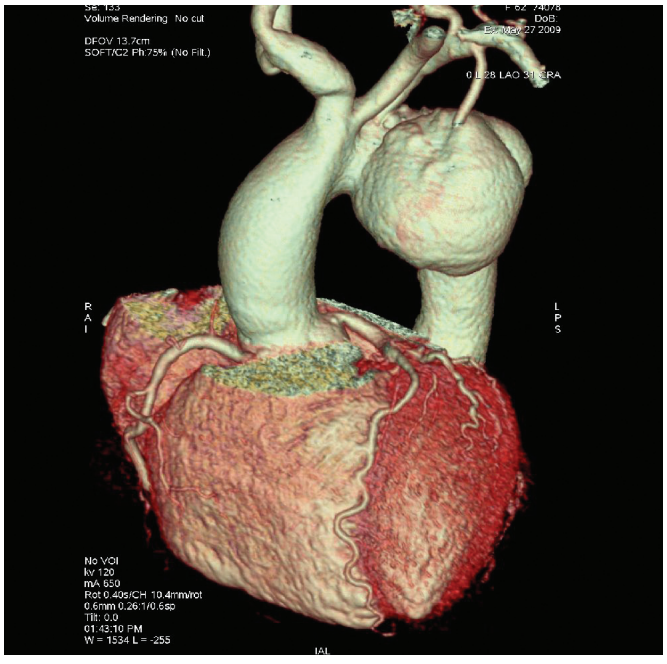

Figure 1. Computed tomography scan of the chest. The volume-rendered reconstruction shows a large saccular aneurysm arising from the arch of the aorta along its inferolateral wall at the level of the origin of the left subclavian artery.

artery, the left common carotid artery (LCCA), and the LSA were circumferentially dissected. After systemic heparinization (100 U/kg) with a target activated coagulation time of 250 to 280 seconds, the ascending aorta was side-clamped. A proximal end-to-side anastomosis was performed with a bifurcated Albograft prosthesis (14 × 7 mm; Biomateriali, Brindisi, Italy). The innominate artery was then temporary clamped at both the proximal and distal ends. With a 5-mm incision on the innominate artery, a Javid shunt (Bard Peripheral Vascular, Tempe, AZ, USA) was rapidly inserted; both clamps were then removed. An end-to-side anastomosis was performed with one end of the Y branch. After flushing, blood flow was reestablished. Then, another branch of the Y graft was used to perform an end-to-side anastomosis with the LCCA. The LSA was anastomosed to another end of the Y graft. Thereafter, all proximal ends of these 3 branches of the aortic arch were ligated. The chest was closed after securing hemostasis.

In stage 2, the left femoral artery was explored. A portable digital C-arm image intensifier (isocentric mobile C-arm; Siemens, Munich, Germany) was used to supervise all procedures of stage 2 in the operation room. A GORE TAG stent graft component (34 × 15 mm; W. L. Gore & Associates, Flagstaff, AZ, USA) was deployed via a left femoral artery approach. The ESG covered the arch of the aorta without occluding the proximal opening of the graft on the ascending aorta. Digital subtraction angiographic analysis of the ascending aorta graft confirmed the proper positioning of the ESG (Figure 2). The patient stayed in the intensive care unit for 2 days and was discharged from the hospital on postoperative day 7. After 1 week, a postoperative computed tomographic angiography evaluation showed a well-deployed endovascular stent with adequate expansion and patent debranching surgical grafts. There was no evidence of endovascular leakage (Figure 3).

DISCUSSION

The morbidity and mortality rates for conventional surgical therapy of aortic arch aneurysm are significant because of the associated CPB and deep hypothermic circulatory arrest. Placement of a stent graft in the thoracic aorta in good surgical candidates remains controversial because the long-term results are unknown. In comparison, the short-term morbidity and mortality rates for endovascular treatment are more favorable. Stent graft placement has proved to be a safe, minimally invasive, and effective treatment for thoracic aortic diseases and is already the best option for many patients. For aortic arch pathologies, however, a range of neurologic and vascular complications may ensue without revascularization of the supra-aortic branches [Görich 2002; Tiesenhausen 2003].

The hybrid procedure combining surgical grafting and intervention stenting is used for treating aortic arch aneurysms in order to avoid CPB and circulatory arrest. It involves debranching of the innominate artery, the LCCA, and the LSA. It also reduces the risk of neurologic and vascular complications.

Hughes et al [2008] reported an alternative antegrade approach for stenting. They made a temporary additional limb from ascending aortic debranching graft. Thereafter, the stent was inserted in an antegrade manner via the proximal limb into the aortic arch to spare the femoral artery [Hughes 2008]. In the presented work, the retrograde approach was used for stenting in order to shorten the duration of the surgery and to minimize the procedures on the single inflow of the aortic debranching graft.

Whether additional transposition of the LSA or the LSA-to-LCCA bypass is necessary before coverage of the LSA origin with an ESG in all patients with normal supra-aortic

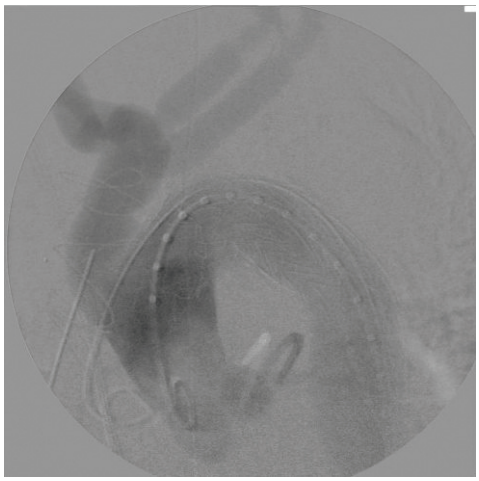

Figure 2. Digital subtraction angiography analysis reveals the debranching graft from the ascending aorta and the proper position of the stent.

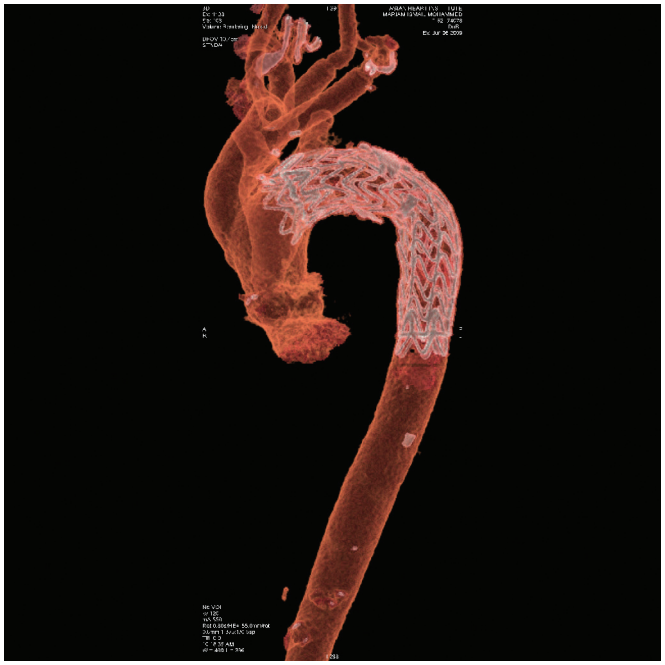

Figure 3. A computed tomography angiogram performed 1 week after surgery revealed patent surgical grafts and a well-placed endovascular stent.

vessels remains controversial [Hausegger 2001; Görich 2002; Weigang 2007]. Bypassing or transposing the LSA in patients with occlusive LSA disease may not be necessary, because such patients usually present with collateral vessel development owing to slow disease progression. Some patients do require additional transposition or bypass of the LSA to the LCCA, however, especially patients who have undergone coronary artery bypass grafting with patent left internal mammary arteries and those who present with carotid or vertebral artery stenosis or anatomic variants of the subclavian, vertebral, or basilar arteries, or the circle of Willis [Rehders 2004; Schoder 2006]. In the present case, the artificial Y graft was used to perform 1 end-to-side anastomosis and 2 end-to-end anastomoses, with only 3 distal anastomoses and 1 proximal anastomosis. With this approach, all 3 branches of the supra-aorta were completely debranched, and the risk of left upper limb ischemia was minimized.

In summary, the hybrid treatment for aortic arch aneurysm that combines debranching and use of an ESG is a safe and minimally invasive procedure. It avoids CPB and deep hypothermic circulatory arrest; however, a large number of cases that use this kind of hybrid procedure and have long-term follow-up results are needed to further prove its effectiveness as a modality for treating aortic arch aneurysm.

REFERENCES

Görich J, Asquan Y, Seifarth H, et al. 2002. Initial experience with intentional stent-graft coverage of the subclavian artery during endovascular thoracic aortic repairs. J Endovasc Ther 9(suppl 2):II39-43.

Hausegger KA, Oberwalder P, Tiesenhausen K, et al. 2001. Intentional left subclavian artery occlusion by thoracic aortic stent-grafts without surgical transposition. J Endovasc Ther 8:472-6.

Hughes GC, Nienaber JJ, Bush EL, Daneshmand MA, McCann RL. 2008. Use of custom Dacron branch grafts for "hybrid" aortic debranching during endovascular repair of thoracic and thoracoabdominal aortic aneurysms. J Thorac Cardiovasc Surg 136:21-8.

Rehders TC, Petzsch M, Ince H, et al. 2004. Intentional occlusion of the left subclavian artery during stent-graft implantation in the thoracic aorta: risk and relevance. J Endovasc Ther 11:659-66.

Schoder M, Grabenwöger M, Hölzenbein T, et al. 2006. Endovascular repair of the thoracic aorta necessitating anchoring of the stent graft across the arch vessels. J Thorac Cardiovasc Surg 131:380-7.

Tiesenhausen K, Hausegger KA, Oberwalder P, et al. 2003. Left subclavian artery management in endovascular repair of thoracic aortic aneurysms and aortic dissections. J Card Surg 18:429-35.

Weigang E, Luehr M, Harloff A, et al. 2007. Incidence of neurological complications following overstenting of the left subclavian artery. Eur J Cardiothorac Surg 31:628-36.