Relocation of supra-aortic vessels to facilitate endovascular treatment of a ruptured aortic arch aneurysm

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Minimally invasive surgery creates new options for patients having a very high risk for morbidity and mortality during conventional operations. A patient with a ruptured thoracic arch aneurysm and a very high comorbidity profile could be treated with these novel techniques. We report on a combined procedure including off-pump coronary bypass grafting, open relocation of the brachiocephalic and left carotid artery, and endovascular exclusion of the thoracic arch aneurysm.

Clinical Summary

A 73-year-old man was admitted urgently to our hospital because of acute onset of chest pain. His chest radiograph revealed a widened mediastinum with some left-sided pleural effusion. Magnetic resonance angiography showed a thoracic arch aneurysm with a diameter of 6 cm, with some contrast leakage around the aneurysm (Figure 1). Because the aneurysm contained the left common carotid and left subclavian artery, it did not seem suitable for endovascular stent grafting. The premedical history of this patient contained angina pectoris, pulmonary embolism, and surgical intervention for a ruptured abdominal aortic aneurysm complicated by adult respiratory distress syndrome and post–adult respiratory distress syndrome pulmonary fibrosis. He also had a high comorbidity profile, including hypertension, chronic obstructive pulmonary disease, obesity, and advanced age. The patient remained hemodynamically stable, and his cardiac work-up was completed with coronary angiography. The coronary angiogram revealed a significant stenosis of the left anterior descending coronary artery (LAD) and the right descending posterior coronary artery (RDP) not suitable for angioplasty and therefore requiring coronary artery bypass grafting.

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The proposed standard solution for this symptomatic arch aneurysm and 2-vessel coronary disease could be conventional coronary artery bypass grafting with aortic arch replacement performed through a midsternotomy with extracorporeal circulation and hypothermic circulatory arrest. However, because of the patient's high EuroSCORE[1] and predicted high mortality rate, if only cardiac surgery was performed, we judged this procedure to be impossible. We therefore invented a combined minimal invasive approach to reduce the operative risk. We performed a combined 3-step procedure (Figure 2). At first the LAD and RDP were bypassed with a venous Y graft on the beating heart. Second, after side clamping the aorta, the brachiocephalic and left common carotid arteries were relocated with a bifurcation prosthesis, and the left subclavian artery was ligated. The anastomoses were performed one after another, and cerebral blood flow was monitored with an ultrasound device. Because of this relocation, a good proximal neck was provided for the third step: endovascular exclusion of the arch with 2 Gore Excluder 7 thoracic endoprostheses (W. L. Gore & Associates, Inc, Flagstaff, Ariz; Figures 1 and 2).

The procedure was completed uneventfully and lasted 280 minutes. One hundred ten milliliters of contrast medium was used, and blood loss was 1200 mL.

Postoperative stay in the intensive care unit lasted 39 days and was complicated by pulmonary infection and repeated respiratory insufficiency. The patient was discharged after 3 months.

Follow-up with spiral computed tomography (CT) after 1 and 6 months showed a type 2 endoleak, with shrinkage of the aneurysmal sac. The patient is clinically doing well.

Discussion

Endovascular repair of aneurysms of the aortic arch with involvement of the branching vessels is still experimental. Because a proximal neck of at least 2 cm is required for good fixation of the graft, relocation of a branching vessel is frequently needed.[2] In this patient relocation of the branching vessels provided a good proximal neck in the ascending aorta. To our knowledge, complete exclusion of the aortic arch in this way has not been reported before.

In addition to his arch aneurysm, this patient also had 2-vessel disease of the LAD and RDP. Although his chest pain was obviously related to his aneurysm, we completed the cardiac work-up with coronary angiography because patients with symptomatic aneurysms are at high risk of death from a myocardial infarction during surgical intervention.[3]

A type 2 endoleak was found after 1 month and was treated conservatively.[4] The importance of a type 2 endoleak is still under discussion as to whether it should be treated and how it should be monitored.[5] The 6-month CT control revealed a smaller type 2

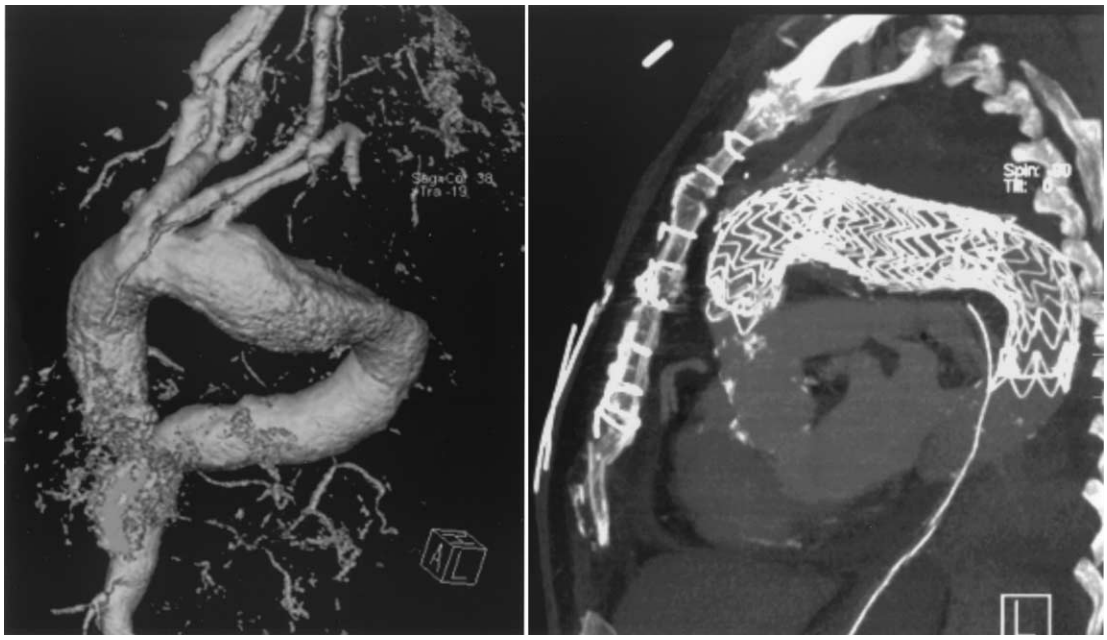

Figure 1. Thoracic arch aneurysm without proximal neck *(left)* and postoperative spiral CT reconstruction showing the position of the 2 endoprostheses in the aortic arch *(right)*.

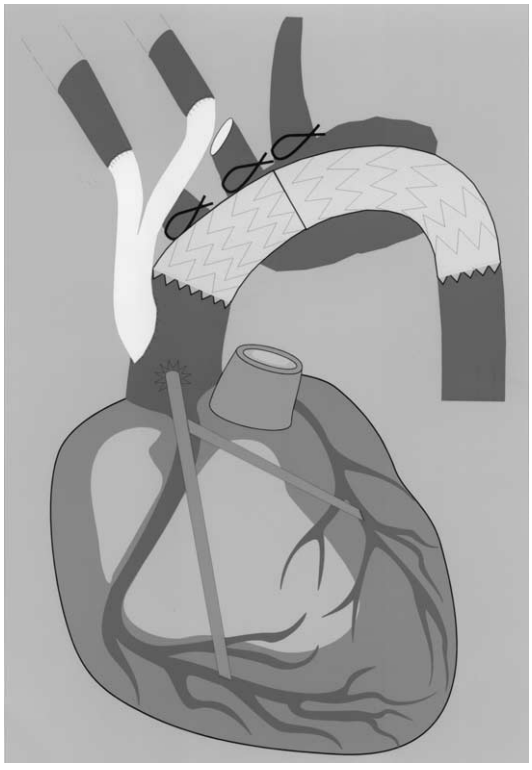

Figure 2. The combined 3-step procedure depicted schematically.

endoleak, with shrinkage of the aneurysmal sac. We will continue our conservative strategy and will repeat a contrast-enhanced spiral CT after 1 year.

Although we used this combination of minimally invasive techniques, our patient still had a complicated postoperative course, but thanks to the abovementioned minimization of risks, he was able to survive this life-threatening ruptured aortic arch aneurysm.

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