Bailout Implantation of a New Single-Branch Stent Graft for the Aortic Arch

Giorgia Cibin, MD, Augusto D'Onofrio, MD, Michele Antonello, MD, Cosimo Guglielmi, MD, Franco Grego, MD, and Gino Gerosa, MD

Divisions of Cardiac Surgery and Vascular Surgery, University of Padova, Padova, Italy

In this paper we describe a case of a rapidly growing pseudoaneurysm of the aortic arch occurring after surgery for acute type A aortic dissection that was successfully treated with an off-the-shelf, single-branch, dual-module aortic arch endovascular stent graft. The main module, which has a side-branch for the innominate artery, was implanted in the aortic arch and in the descending thoracic aorta. The second module was deployed in the ascending aorta and connected to the main module through a proprietary interlocking system. Final angiography showed complete exclusion of the pseudoaneurysm and good patency of the supraaortic vessels.

(Ann Thorac Surg 2020;110:e371-3)

Endovascular stent grafting of the descending thoracic and abdominal aorta is considered as the gold standard treatment for diseases involving these aortic segments. Recently, endovascular stent grafting of the aortic arch has shown initial promising results in highly selected patients. The endovascular treatment of the aortic arch presents some peculiar challenges that are mainly related to the anatomic variability of the supraaortic vessels in terms of origin, size, and take-off angle, and also to the possible important difference in diameter between the ascending and descending aorta.[1]

There are basically two different types of endovascular stent grafts for the aortic arch: fenestrated[2] and branched.[3] The latter comes in two different configurations: double branch and single branch. Custom-made double-branch endografts enable the revascularization of two supraaortic vessels (generally the innominate artery and the left common carotid artery), thereby reducing, and sometimes avoiding, the need for extra anatomic bypass. However, they require 4 to 5 weeks for manufacturing and therefore they cannot be used for urgent or emergent cases. Conversely, off-the-shelf single-branch endografts allow the revascularization of only one supraaortic vessel (generally the innominate artery), therefore requiring surgical bypass of the remaining vessels. Owing to their ready availability, single-branch off-the-shelf aortic arch endovascular prostheses are a valid option in case of urgent and emergent cases. We describe here a case of a rapidly growing aortic arch pseudoaneurysm that developed after open surgery for a type A acute aortic dissection that was rapidly treated using a new single-branch bimodular stent graft.

A 74-year-old man with a history of chronic obstructive pulmonary disease, smoking, myocardial infarction, right nephrectomy due to cancer, diabetes mellitus, hypertension, and dyslipidemia arrived to the emergency room with type A acute aortic dissection. The patient underwent replacement of the aortic valve and of the hemiarch with a button-Bentall operation with open distal anastomosis. The postoperative period was uneventful. Predischarge computed tomography angiogram showed a pseudoaneurysm of the left posterolateral side of the ascending aorta at the level of the distal anastomosis (Figure 1A). One week later, a new computed tomography angiogram showed significantly increased dimension of the pseudoaneurysm with compression of the pulmonary artery (Figure 1B).

After multidisciplinary assessment, because of the patient's comorbidities, the rapid growth of the pseudoaneurysm, and the risk of fistulization into the pulmonary artery, the patient was scheduled for pseudoaneurysm exclusion with an off-the-shelf single-branch aortic arch stent graft: the Nexus stent graft system (Endospan, Herzlia, Israel). It consists of two different modules: the main module is deployed in the innominate artery and in the aortic arch; the second module is placed in the ascending aorta and is connected to the main module through a proprietary interlocking system. An innominate artery, left common carotid artery, left subclavian artery bypass was surgically performed.

Six days later, to allow complete recovery from the bypass surgery, the endovascular procedure was carried out. Nevertheless, a combined operation, bypass, and endovascular procedure at the same time, although technically feasible, would be long and with less neurologic control than a staged approach. The Nexus device was implanted with the standard technique that has been already described.[4] Briefly, the main module was implanted using an axillofemoral through-and-through guidewire. Then, during rapid ventricular pacing, the ascending module was deployed on a guidewire placed in the left ventricle as in a transfemoral transcatheter aortic valve implantation procedure (Video). Intraoperative angiography showed good device positioning with no type 1 or type 3 endoleaks. Type 2 endoleak was treated with a 20-mm vascular plug in the left subclavian artery. Final angiography showed complete exclusion of the pseudoaneurysm and good patency of the supraaortic vessels. The entire procedure lasted approximately 150

Accepted for publication Mar 22, 2020.

Address correspondence to Dr D'Onofrio, Division of Cardiac Surgery, University of Padova, Viale Giustiniani 2, Padova 35128, Italy; email: adonofrio@hotmail.it.

The Video can be viewed in the online version of this article [https://doi.org/10.1016/j.athoracsur.2020.03.094] on http://www.annalsthoracicsurgery.org.

0003-4975/$36.00
https://doi.org/10.1016/j.athoracsur.2020.03.094

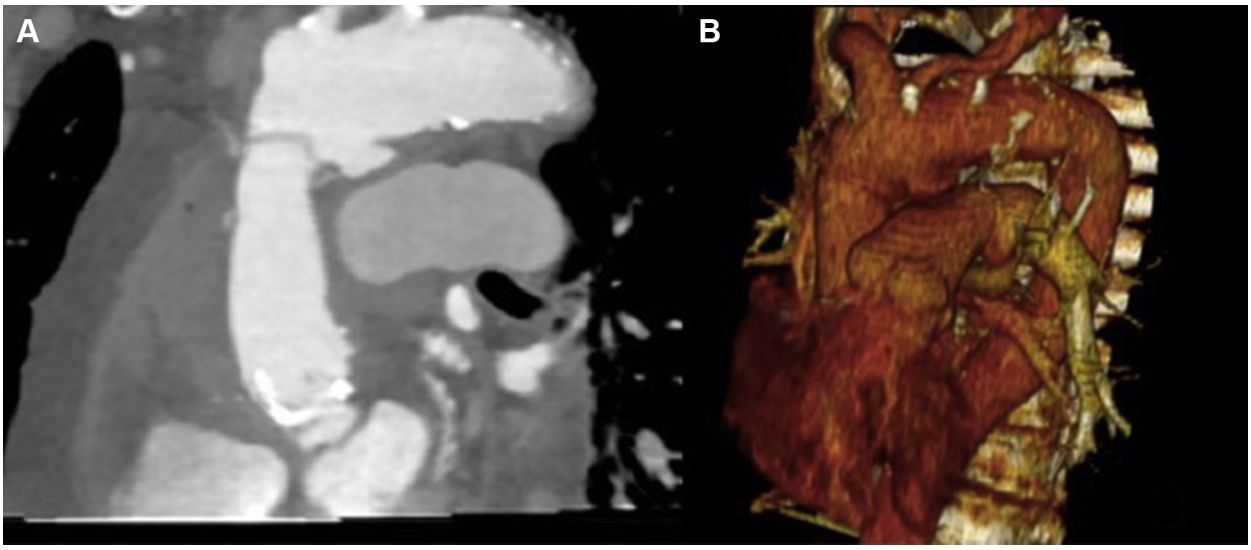

Figure 1. (A) Computed tomography angiogram shows aortic arch pseudoaneurysm at the level of the distal anastomosis. (B) Three-dimensional reconstruction shows compression on the pulmonary artery.

minutes; fluoroscopy time was 42 minutes, and contrast volume was 160 mL.

The patient was extubated after 14 hours and intensive care unit stay was 3 days. Subsequent hospital stay was uneventful, and the patient was discharged to a rehabilitation facility after 7 days. The computed tomography angiogram performed 6 months later confirmed the good procedural result with no endoleaks and complete pseudoaneurysm exclusion (Figure 2).

Comment

This case shows that urgent endovascular treatment of the aortic arch with an off-the-shelf single-branch bimodular aortic arch stent graft is feasible and can be performed with good early outcomes. The pathologies of the aortic arch are currently treated using conventional open surgery, which remains the gold standard. However, for high-risk patients, postoperative mortality and complications are significantly higher. In this subgroup of

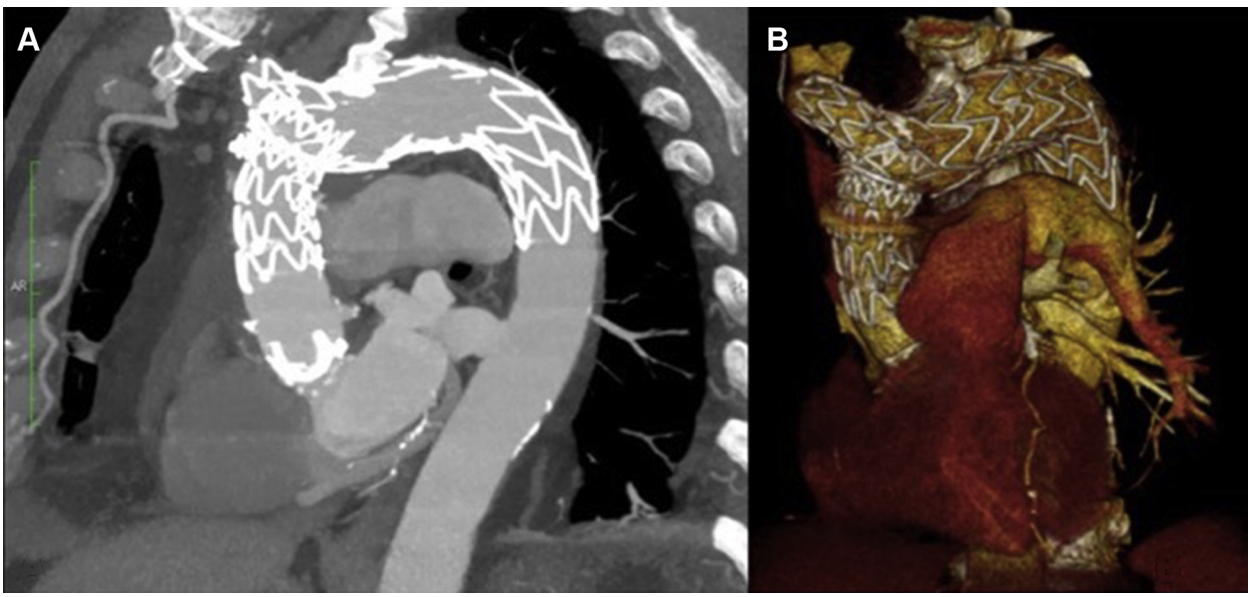

Figure 2. Six-month computed tomography angiogram control. (A) Lateral view shows good positioning of the aortic arch endograft with complete exclusion of the pseudoaneurysm. (B) Three-dimensional reconstruction shows complete aortic arch exclusion and side branch in innominate artery.

patients, an alternative option is represented by endovascular stent grafting of the aortic arch with branched devices. This microinvasive approach[5] allows us to treat aortic arch diseases with no extracorporeal circulation, on the beating heart, and with no circulatory arrest. Therefore, the impact of surgery on these already delicate and fragile patients decreases significantly. The different available devices—custom-made and off-the-shelf, single or double-branch—enable a precise tailoring of the procedure based on the characteristics of every single patient.

In the described case, the choice to implant an off-the-shelf single-branch device was driven by the patient's high-risk profile (comorbidities and recent operation) and by the rapid growth of the aneurysm with potential imminent rupture into the pulmonary artery. Despite the good early outcome, this patient will be closely followed up to evaluate medium- and long-term results especially in terms of device stability, connection of the two modules, and patency of the supraaortic bypass. In conclusion, for highly selected patients, urgent endovascular treatment of aortic arch pseudoaneurysm is feasible and should be considered as a potential therapeutic option.

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