



A New Off-Pump Hybrid Open and Endovascular Repair to Treat Ductus Botalli and Ascendens Aneurysms

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Abstract

To report a combined ascending aorta and aortic arch hybrid repair, we performed off-pump with no aortic graft replacement. A 65-year-old man, developing progressive recurrent laryngeal nerve paralysis, underwent a computed tomography (CT) angiography detecting nonpatent residual ductus Botalli aneurysm and ascending aorta aneurysm. Due to severe multimorbidities, a less-invasive alternative was elaborated. In a first step, appropriate proximal landing zone for aortic stent grafting was achieved by ascending aorta diameter reduction, with epiaortic wrapping, and debranching the supra-aortic trunks. In the second step, endovascular stent grafts were deployed from proximal ascending aorta to descending aorta, excluding the ductus Botalli aneurysm. Six-month follow-up CT shows ductus Botalli aneurysm exclusion, stable stent graft position, and ascending diameter and patent and stenosis-free supra-aortic grafts. This case supports this alternative treatment to open aortic repair under circulatory arrest and deep hypothermia, especially in those patients considered unfit for such invasive treatment.

Keywords

aortic arch, aortic operation, carotid arteries, endovascular procedures, vascular disease

Introduction

Residual ductus Botalli aneurysm is reported in the worldwide literature in less than 100 patients and even more rare is its manifestation in adults at an advanced age.¹ To treat this lesion involving the aortic arch, an open graft repair is usually performed under deep hypothermia and circulatory arrest (DHCA). This approach is generally restricted to patients considered fit for such invasive surgery. A hybrid open and endovascular repair of a rare case presenting nonpatent residual ductus Botalli aneurysm combined with ascending aorta aneurysm is reported.

Technique

A computed tomography (CT) scan demonstrated a nonpatent residual ductus Botalli aneurysm (57 mm) in a 65-year-old patient with progressive recurrent laryngeal nerve paralysis, associated to an ascending aortic aneurysm (47 mm; Figure 1). The alcoholic and currently smoker patient had a poor nutritional state and severe obstructive pulmonary disease. To treat this combined aortic pathology in a patient with high-risk profile for conventional open surgery, a staged 2-step hybrid open and endovascular repair procedure was elaborated. The first step consisted of reducing ascending aorta diameter by

epiaortic wrapping and a 4-vessel debranching of the supra-aortic trunks. The ascending aorta was wrapped with a polypropylene mesh (PROLENE; Ethicon Inc, Sommerville, NJ). At the beginning, the mesh was fixed dorsally to the ascending aorta with 2 anchoring stitches: proximally just above the coronary sinus and distally just below the origin of the brachiocephalic trunk. Subsequently, the mesh was sutured in correspondence to the anterior wall of ascending aorta with a longitudinal polypropylene 3.0 running suture beginning at the sinotubular junction and ending just proximally to the brachiocephalic trunk. The mesh suture was placed to obtain a reduction in the ascending aorta diameter to approximately 30 to 35 mm. Next, all the supra-aortic trunks were bypassed using an octopus graft constructed from a 14- × 7-mm bifurcated

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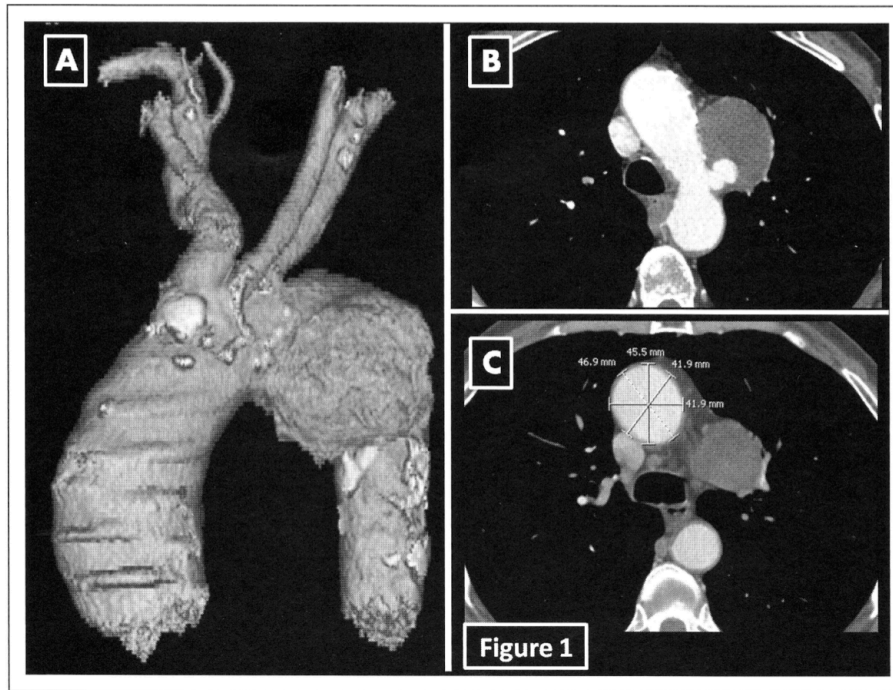


Figure 1. Preoperative computed tomography angiography. A, Three-dimensional reconstruction showing ductus Botalli and ascending aortic aneurysms. B, Residual ductus Botalli aneurysm in axial view. C, Ascending aortic aneurysm (maximal diameter of 47mm).

polyester graft with 2 additional side arms. The octopus graft was anastomosed proximally in the wrapped ascending aorta with a polypropylene 3.0 running suture. Distally, both common carotid arteries and the left subclavian artery were anastomosed with the Viabahn Open Revascularization TEChnique²; the right subclavian artery was revascularized with end-to-side polypropylene 5.0 running suture technique. All native supra-aortic vessels were tied proximally to the anastomosis site (Figure 2A). The postoperative CT documented a diameter of the ascending aorta of 32 mm and patent supra-aortic bypasses without any sign of stenosis. The second step, thoracic endovascular aneurysm repair (TEVAR), was performed 4 weeks later. For TEVAR, 2 devices were implanted percutaneously transfemorally under local anesthesia. First, a TAG (W.L. Gore and Assoc, Flagstaff, Arizona) of 31 mm/15 cm stent graft was deployed from the proximal descending to the proximal arch (zones 4-1). This was followed by the deployment of a second TAG (W.L. Gore and Assoc) of 37 mm/15 cm endograft landing in the proximal ascending aorta (zone 0). Completion angiography confirmed complete exclusion of the ductus Botalli aneurysm and patency of all supra-aortic trunks bypasses (Figure 2B). At 6-month follow-up, the CT scan confirmed stable ascending aortic diameter, patency of all supra-aortic vessels without any stenoses, and complete exclusion of the residual ductus Botalli aneurysm with slight decrease in diameter (Figure 3).

Comment

Residual ductus Botalli aneurysm is a rare condition which can manifest in elderly patients, occasionally associated with widened or aneurysmal ascending aorta.³ The pathologic

mechanism of ductus Botalli aneurysm is thought to be the consequence of a failed closure of the aortic side of the ductus, which leads to aneurysmal dilatation of immature tissue due to systemic pressure.⁴ In adult patients, the symptoms associated with the ductus Botalli aneurysm are generally the consequence of the growing process and its mass effect on contiguous structures. Ductus Botalli aneurysm complications such as rupture, dissection, infection, and distal embolization have been reported with catastrophic outcomes.³ When a ductus Botalli aneurysm is diagnosed, operative treatment is required, especially in patients presenting symptoms or in aneurysms rapidly growing.¹ Usually, residual ductus Botalli aneurysm is addressed with DHCA and open arch repair. Unfortunately, this approach shows high complication rate, with perioperative mortality rates of up to 16.5% and stroke rates⁵ around 18%. Considering the increasingly aging population, with often significant comorbidities, new techniques of repair are required to avoid DHCA surgery.⁶ Complete endovascular repair using branched/fenestrated stent grafts is attractive, but till now the overall experience is very limited. Moreover, these techniques might be risky, as thrombotic or atherosclerotic deposits in the arch or arch branches might induce cerebral embolization secondary to endoluminal manipulations. The supra-aortic debranching is a less-invasive procedure that has been reported to be a durable treatment with patency rate⁷ at 5 years of 92%. In our case, ascending aortic aneurysm precluded stent graft landing in zone 0 and therefore complete endovascular repair was not possible. Ascending aorta wrapping has been introduced in the 80s and showed to be a safe, less-invasive and durable alternative to the graft repair of the ascending aorta.⁸ The overall procedure

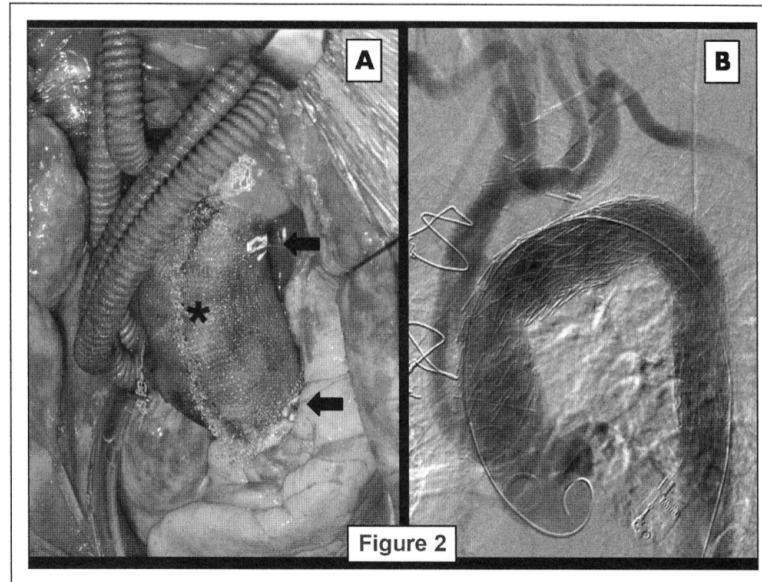


Figure 2. Procedures. A, Open surgery. Epiaortic ascending wrapping and supraaortic trunks debranching. Arrows: Polypropylene mesh anchoring stitches; *longitudinal polypropylene running suture. B, Thoracic endovascular aneurysm repair: angiography showing complete exclusion of ductus Botalli aneurysm and patent supraaortic trunks.

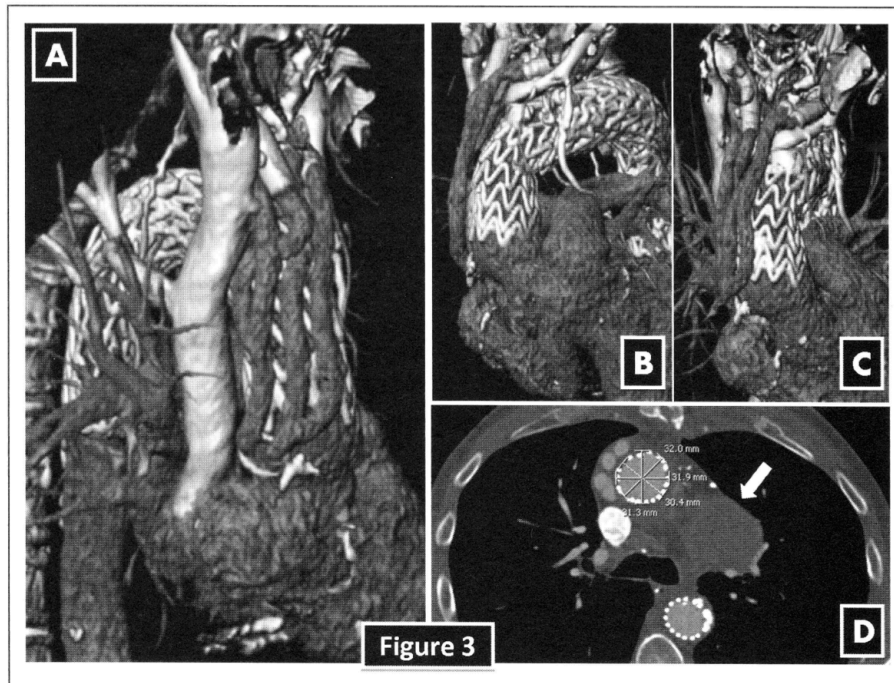


Figure 3. Follow-up computed tomography angiography performed 6 months postoperative. A,B,C, three-dimensional reconstructions showing patent supraaortic trunks and thoracic endovascular aneurysm repair extending from zone 0 to zone 4. D, Maximal aortic diameter of ascending aorta. Arrow: complete thrombosis of the residual ductus Botalli aneurysm.

was staged to reduce the debranching operative time once the femoral access for TEVAR was feasible. This option was successful in short term and at 6 months of follow-up, with CT angiography showing stable diameter of the ascending aorta, patent bypass grafts to the supra-aortic vessels, and complete exclusion of the ductus aneurysm. This is

to our knowledge the first report describing a combined off-pump ascending aorta and aortic arch hybrid repair, without performing any aortic graft replacement. This combined procedure seems to be an attractive alternative to open aortic arch graft repair under DHCA, especially in patients considered unfit for such a procedure.

Declaration of Conflicting Interests

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