

Aneurysm Hybrid Treatment by Simultaneous Replacement of Ascending Aorta and Aortic Arch and Endoluminal Stenting of the Descending Aorta



Dr. Riess



Friedrich-Christian Riess, MD,¹ Hans Krankenberg, MD,² Thilo Tübler, MD,² Matthias Danne, MD¹

¹Albertinen Heart Center; ²Center for Cardiology, Hamburg, Germany

ABSTRACT

Background. Resection of the descending thoracic aorta and replacement with a vascular prosthesis is associated with an increased risk of paraplegia, as opposed to endoluminal stenting. We report on the first case in which a thoracic aortic aneurysm was treated in a hybrid approach, combining surgery with the implantation of a new intraluminal stent during 1 procedure.

Methods. A 76-year-old man with long-standing hypertension suffered from acute chest pain. Magnetic resonance imaging (MRI) revealed a complex aortic aneurysm with increased diameters of the ascending aorta (55 mm), the aortic arch (75 mm), and the descending aorta (50 mm). Supracoronary replacement of the ascending aorta with a 30-mm prosthesis was carried out during cardiopulmonary bypass, cardioplegic arrest, and hypothermia (25°C). Surgery and stenting were carried out during circulatory arrest and antegrade cerebral perfusion. Two stents (length: 23 cm and 17 cm) were placed in the descending aorta via the opened aortic arch under X-ray control, covering the left subclavian artery. Then aortic arch replacement was finished by anastomosing the distal end of the aortic prosthesis to the proximal stent's customized proximal end (Polyester cuff, length 25 mm/diameter 36 mm) together with the aortic wall. The brachiocephalic trunk and left carotid artery along with a vein graft to the left subclavian artery were implanted in the prosthesis.

Results. Postoperative course was uneventful except for a pericardial effusion. MRI revealed normal dimensions of the thoracic aorta with complete exclusion of the aneurysm and no leakage.

Conclusion. Simultaneous replacement of ascending aorta and aortic arch with antegrade endoluminal stenting of the descending aorta using a new type of stent were safely and effectively performed in a patient with an aortic aneurysm.

INTRODUCTION

Surgery of the thoracic aorta is associated with significant morbidity and mortality. In particular, resection of the descending thoracic aorta and replacement with a vascular prosthesis carry an increased risk of paraplegia [Svensson 1998]. On the other hand, for patients undergoing endoluminal stenting of the descending thoracic aorta, the risk for paraplegia is described as no more than 2.9% [Mitchell 1999; Cambria 2002]. We report the first case in which a complex thoracic aortic aneurysm was treated in a hybrid approach, combining surgical replacement of the ascending aorta and the aortic arch with stenting of the descending aorta using a new type of stent placed via the opened aortic arch during 1 surgical procedure.

MATERIALS AND METHODS

A male patient, age 76 years (63 kg, 190 cm), with long-standing hypertension suffered from acute chest pain. Magnetic resonance imaging (MRI) revealed a complex aortic aneurysm with increased diameters of the ascending aorta (55 mm), the aortic arch (75 mm), and the descending aorta (50 mm) (Figure 1A). The aortic valve was competent. Furthermore, a coronary angiogram was performed and revealed normal coronary arteries without significant stenosis. Supracoronary replacement of the ascending aorta with a 30-mm prosthesis was carried out during cardiopulmonary bypass (CPB), cardioplegic arrest with modified 15°C cold blood cardioplegia, and hypothermia (25°C) (Figure 2). Surgery and stenting procedure were carried out during circulatory arrest and antegrade cerebral perfusion. Two stents (E-vita open; Jotec, Hechingen, Germany; length 23 cm and 17 cm) (Figure 3) were placed in the descending aorta via the opened aortic arch under X-ray control, covering the left subclavian artery, which was ligated to avoid bleeding from the descending aneurysm. The total descending aorta was stented down to the diaphragm. Aortic arch replacement was finished by anastomosing the distal end of the aortic prosthesis to the

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Address correspondence and reprint requests to: PD Dr. Friedrich-Christian Riess, Albertinen Heart Center, Süntelstr. 11a, D-22457 Hamburg, Germany; 49-0-40-5588-2445; fax: 49-0-40-5588-2421 (e-mail: friedrich-christian.riess@albertinen.de).

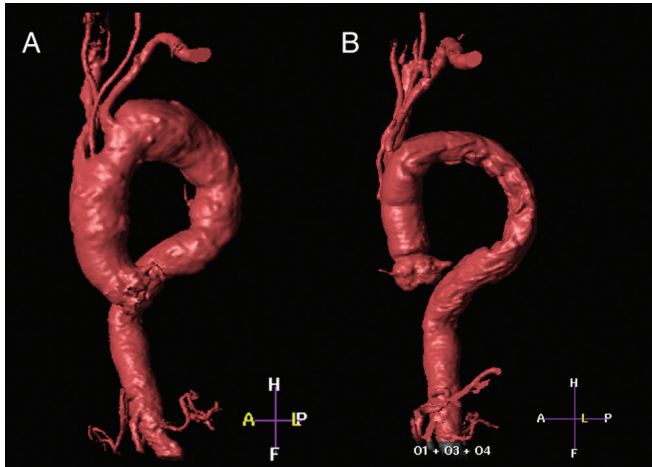


Figure 1. (A) Preoperative and (B) postoperative magnetic resonance imaging of a patient undergoing aneurysm hybrid treatment with simultaneous replacement of the ascending aorta and aortic arch and endoluminal stenting of the descending aorta.

proximal stent's customized proximal end (Polyester cuff; length 25 mm, diameter 36 mm) together with the aortic wall. The brachiocephalic trunk and left carotid artery with a vein graft to the left subclavian artery were implanted into the prosthesis (Figure 2). De-airing was performed using retrograde cerebral perfusion via superior caval vein.

RESULTS

The patient was postoperatively ventilated for 15 hours. Total blood loss through thoracic drainages was 1450 mL. The total amount of packed red cells and fresh frozen plasma was 600 mL. Postoperative anticoagulation was performed with heparin (3×7500 U day) and from day 6 with acetylsalicylic acid (100 mg/day). An atrial fibrillation on the first postoperative day was successfully electrically converted to a stable sinus. Postoperative course was uneventful except for pericardiocentesis on the twelfth postoperative day due to signs of pericardial tamponade. Intraoperatively, a serous effusion of 400 mL was found. Postoperative MRI revealed normal dimensions of the thoracic aorta with complete exclusion of the aneurysm and no leakage. The patient was discharged in good condition on the sixteenth postoperative day with a hemoglobin value of 12.3 mg/dL. Six months after hybrid treatment of the aortic aneurysm, the patient was in good condition without chest pain and showed no neurological deficits.

DISCUSSION

Paraplegia is a well-recognized and feared complication of surgical procedures involving the thoracic and thoracoabdominal aorta [Svensson 1998]. The conventional surgical approach for aneurysms affecting the ascending aorta, aortic arch, and descending aorta is the “staged elephant trunk,” first described by Borst et al in 1983 [Borst 1999]. First, the ascending aorta and the aortic arch aneurysm are resected

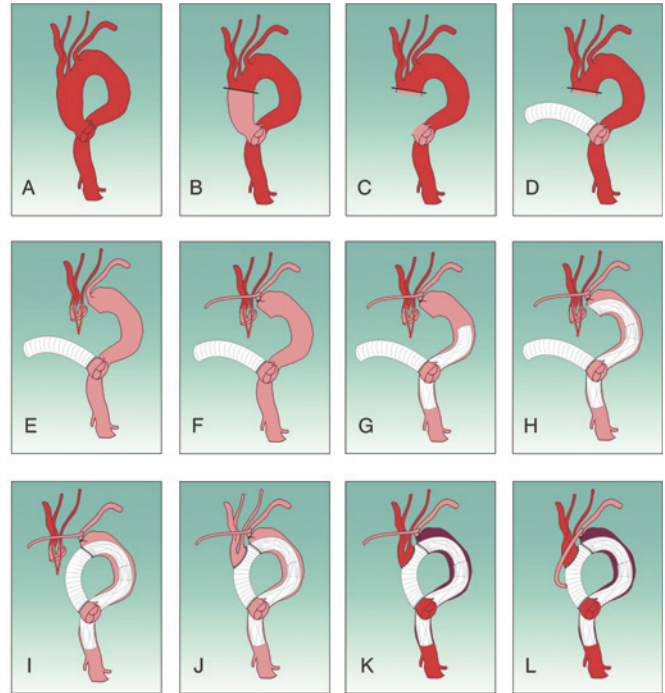


Figure 2. Technical aspects in aneurysm hybrid treatment in a patient undergoing simultaneous replacement of the ascending aorta and aortic arch and endoluminal stenting of the descending aorta. (A) Complex aortic aneurysm, (B) clamping of ascending aorta and (C) resection, (D) supracoronary aortic replacement, (E) circulatory arrest and antegrade perfusion of both carotid arteries, (F) ligation of subclavian artery and anastomosing of vein graft, (G) implantation of distal stent, (H) overlapping implantation of proximal stent, (I) suturing of ascending prosthesis to proximal stent, (J) implantation of supraaortic vessels into aortic prosthesis, (K) reinitiation of cardiopulmonary bypass, and (L) implantation of vein graft into aortic prosthesis.

and replaced with a prosthesis using CPB, deep hypothermia, and circulatory arrest. A residual length of graft is left in the descending aorta to facilitate repair of the descending aortic aneurysm at a later stage. However, this approach involves 2 major surgical procedures, with their corresponding risks and complications. Because of this, some patients are unable to have the repair completed.

Another single stage repair of the ascending aorta, aortic arch, and descending thoracic aorta via median sternotomy through a transmediastinal approach has been described by Beaver and colleagues [Beaver 2001]. The operation is performed with CPB and deep hypothermia, circulatory arrest and retrograde cerebral perfusion. First, a Dacron graft is anastomosed to the distal descending aorta through a transmediastinal transverse supradiaphragmatic aortotomy incision. Then, arch vessels are implanted in the prosthesis. Finally, the prosthesis is sutured to the ascending aorta. The authors reported a perioperative mortality of 14%, with a 21% incidence of neurologic injury.

The underlying idea for the described hybrid approach is that replacement of the ascending aorta and aortic arch can be carried out with a relatively low procedural risk. On the

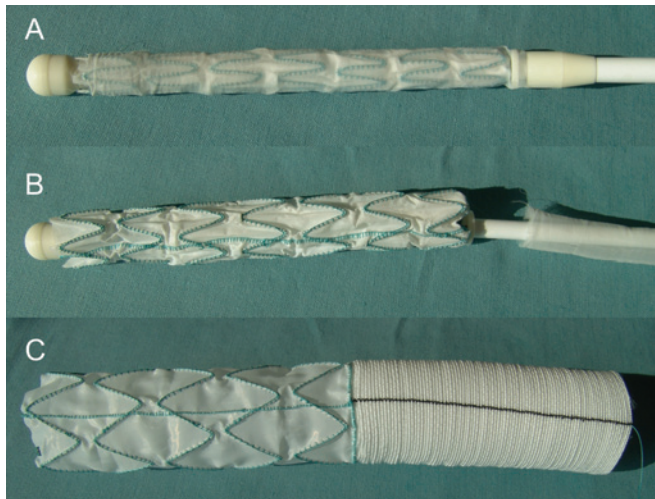


Figure 3. (A) New endoluminal stent (E-vita open, Jotec, Hechingen, Germany) unreleased, (B) released, and (C) fully expanded with the customized polyester cuff pulled out.

other hand, endoluminal stenting of the descending aorta has been described to have low risk rates for paraplegia [Svensson 1998], especially when compared to surgical replacement with a vascular prosthesis [Mitchell 1999; Cambria 2002]. However, endoluminal stenting in our case was carried out with use of CPB, hypothermia, and circulatory arrest, which might have negative consequences for the blood supply to the spinal cord.

In this patient, 2 stents were implanted in an overlapping fashion to cover the total length of the descending thoracic aorta down to the diaphragm. The reason for this was that with increasing length of a stent its launching gets more difficult because of friction, especially in curved vessels such as the aortic arch.

As the left subclavian arteria derived from the extensively enlarged aortic arch and the distance between the left subclavian artery and the left carotid artery was relatively long because of longitudinal enlargement, the surgical mobilization of the left subclavian artery to reach the aortic prosthesis was not possible. Despite a good backflow of blood from the left subclavian artery, we decided to ligate and bypass the subclavian artery to prevent bleeding from the descending aneurysm and to optimize the blood supply to the spinal chord.

In conclusion, simultaneous replacement of the ascending aorta and aortic arch and endoluminal stenting of the descending aorta using a new type of stent were safely and effectively performed in a patient with a complex aortic aneurysm. The described technique has the advantage that the entire aneurysm is treated during 1 procedure, avoiding the risk and stress of a second operation. This special prosthesis can be easily and quickly positioned via the opened aortic arch into the descending aorta, and risk of endoleakage is avoided because the stent is directly fixed to the aortic arch prosthesis.

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