

Surgical Treatment of Interrupted Aortic Arch with Extraanatomical Bypass Simultaneous to Coronary Artery Bypass Grafting and Aortic Valve Replacement

Friedrich-Christian Riess, Matthias Danne, Jan-Hendrik Stripling,
Heinz Bergmann, Niels Bleese

Albertinen Hospital, Hamburg, Germany



Dr. Riess



ABSTRACT

An interrupted aortic arch accompanied by further surgically reparable cardiac lesions is a rare combination in adult patients. We describe treatment of an interrupted aortic arch, coronary artery bypass grafting (CABG), and aortic valve replacement (AVR) performed simultaneously through median sternotomy in a 64-year-old man. The patient underwent surgery performed using standard cardiopulmonary bypass with cannulation of the ascending aorta and the right atrium, hypothermia (24.6°C), and blood cardioplegic arrest. Four aortocoronary vein grafts and pericardial aortic valve replacement were carried out. Finally, the posterior pericardium was opened, and a 16-mm prosthesis was anastomosed to the descending aorta during side clamping using a 4-0 monofilament continuous suture. Optimal placement of the prosthesis was obtained by guiding it to the ascending aorta laterally to the right atrium and passing it between the inferior vena cava and right inferior lung vein. The operation was carried out without complications, and the postoperative course was uneventful. Magnetic resonance imaging showed competent aortic valve prosthesis and highly decreased collateral flow via the internal mammary arteries. Postoperatively both inguinal pulses were present, and the patient was free of angina. In the presence of an interrupted aortic arch, extraanatomical bypass via the posterior pericardium between the ascending and descending aorta can safely be performed at the same time as CABG and AVR through a median sternotomy.

INTRODUCTION

An interrupted aortic arch accompanied by further surgically reparable cardiac lesions is a rare combination in adult patients.

Presented at the 10th Annual CTT Meeting 2004, Miami Beach, Florida, USA, March 10-13, 2004.

Address correspondence and reprint requests to: Friedrich-Christian Riess, MD, Albertinen-Krankenhaus Hamburg, Abt. für Herzchirurgie, Suentelstrasse 11a, 22457 Hamburg, Germany; 49-40-5588-2445; fax: 49-40-5588-2421 (e-mail: friedrich-christian.riess@albertinen.de).

A simultaneous operative approach appears to be more comfortable for patient and surgeon and might be associated with a lower morbidity and mortality. Furthermore there is no need for extensive mobilization of the aorta, and complications such as spinal cord injury, damage to the recurrent laryngeal or phrenic nerves, and chylothorax can be avoided. Simultaneous surgery of thoracic aortic coarctations and intracardial pathology has been reported by different authors [Vijayanagar 1980, Thomka, 1997, Morris 1998]. We describe simultaneous treatment of an interrupted aortic arch, coronary artery disease, and aortic valve regurgitation with an extraanatomical ascending-to-descending bypass, aortic valve replacement (AVR), and coronary artery bypass grafting (CABG) through a median sternotomy.

CASE REPORT

A 64-year-old man (wt 75 kg) showed progredient stress dyspnoe (New York Heart Association class III) and angina (Canadian Cardiovascular Society class 3) due to severe aortic valve regurgitation and coronary artery 3-vessel disease. In addition to upper-body arterial hypertension (170/70 mm Hg) the patient showed pulseless extremities and hypoplasia of the legs. Preoperative magnetic resonance imaging (MRI) (Intera CV, 1.5 T; Philips Medical Systems, The Netherlands) demonstrated an interrupted aortic arch directly after the origin of the left subclavian artery (Figure 1) and a calcified bicuspid aortic valve with severe regurgitation and poststenotic dilatation of the ascending aorta. The patient underwent surgery using median sternotomy, standard cardiopulmonary bypass (CPB) with cannulation of the ascending aorta and the right atrium, hypothermia (24.6°C), and blood cardioplegic arrest. Four aortocoronary vein grafts to the diagonal branch, 2 marginal branches, and posterior descending branch of the right coronary artery were performed. Additionally pericardial AVR (Perimount 27 mm; Edwards Lifesciences, Irvine, CA, USA) and a reduction plasty of the ascending aorta were performed. Finally, the posterior pericardium was opened longitudinally directly over the descending thoracic aorta, and during side clamping a 16-mm prosthesis (Uni-Graft K DV; Braun, Aesculap, Tuttlingen, Germany) was anastomosed to the descending aorta using a 4-0 polypropylene continuous suture (Figure 2A). The bypass prosthesis was directed anterior to the esophagus and routed posterior to the vena cava and anterior to the right inferior pulmonary vein. The bypass was guided to the

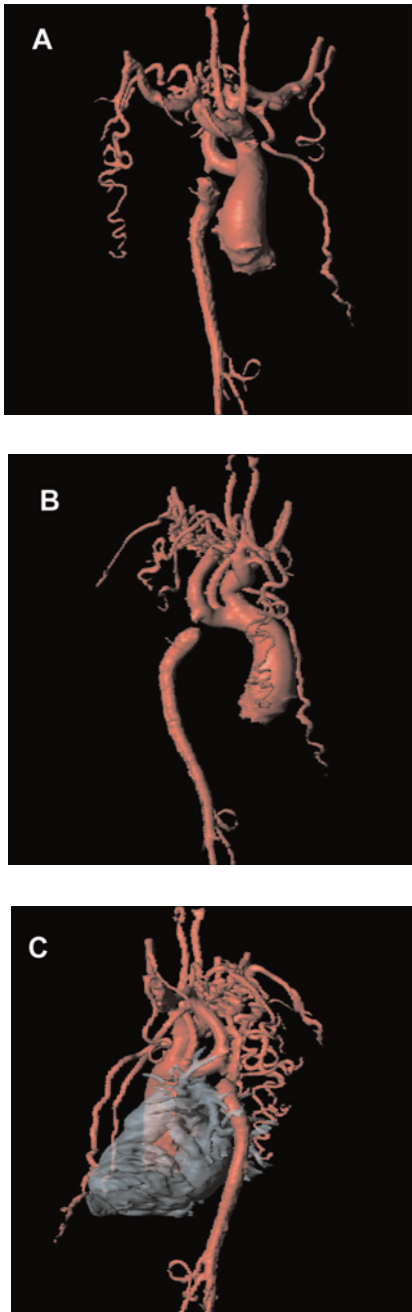


Figure 1. Three-dimensional rendering of contrast-enhanced magnetic resonance angiography showing aortic arch interruption from anterior (A), right lateral (B), and left lateral with both ventricles and the collateral system (C).

ascending aorta around the right atrium and anastomosed to the right lateral ascending aorta during aortic cross clamping (Figures 2B and 2C).

Total CPB time was 240 minutes and aortic cross-clamp time 207 minutes. The operation was carried out without complications, and the postoperative course was uneventful. The patient was extubated 28 hours after surgery. Total blood loss through drainage was 1150 mL. Postoperative MRI

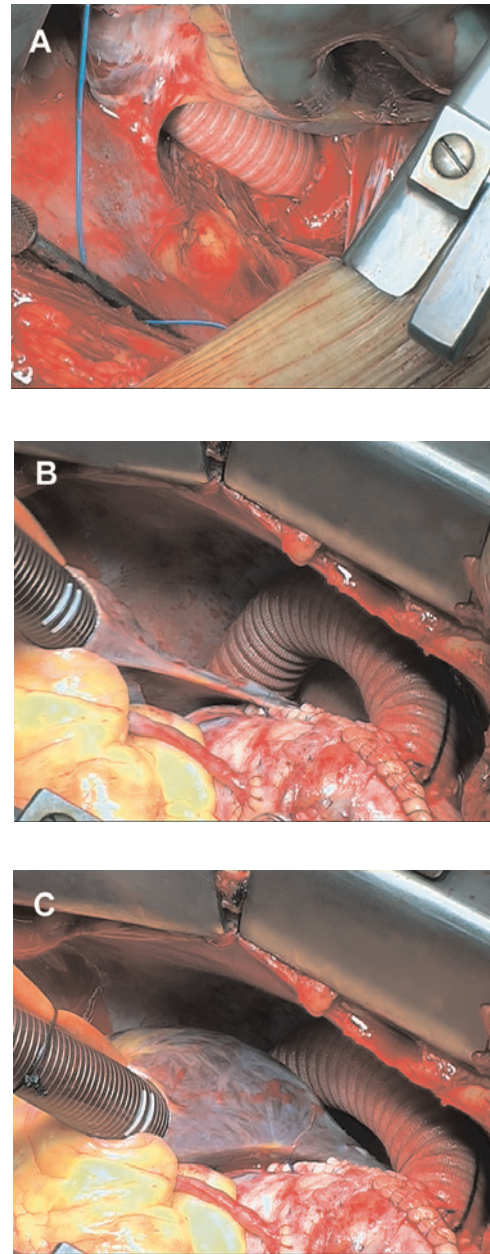


Figure 2. Intraoperative views of the extraanatomical bypass from ascending to descending aorta. A, Distal bypass anastomosis to the descending aorta. The prosthesis is guided to the ascending aorta laterally to the right atrium, passing between inferior vena cava and right inferior lung vein in order to obtain optimal placement. B and C, Views of the extraanatomical bypass and proximal anastomosis to the ascending aorta during (B) and after (C) cardiopulmonary bypass.

demonstrated a competent aortic valve prosthesis, highly decreased collateral flow via the internal mammary arteries, and harmonic placement of the extraanatomical bypass (Figure 3). Postoperatively both inguinal pulses were present and the patient was free of angina. Systolic blood pressure decreased after surgery from 170/70 to 130/70 mmHg. The patient was discharged from hospital in good condition at the 10th postoperative day.

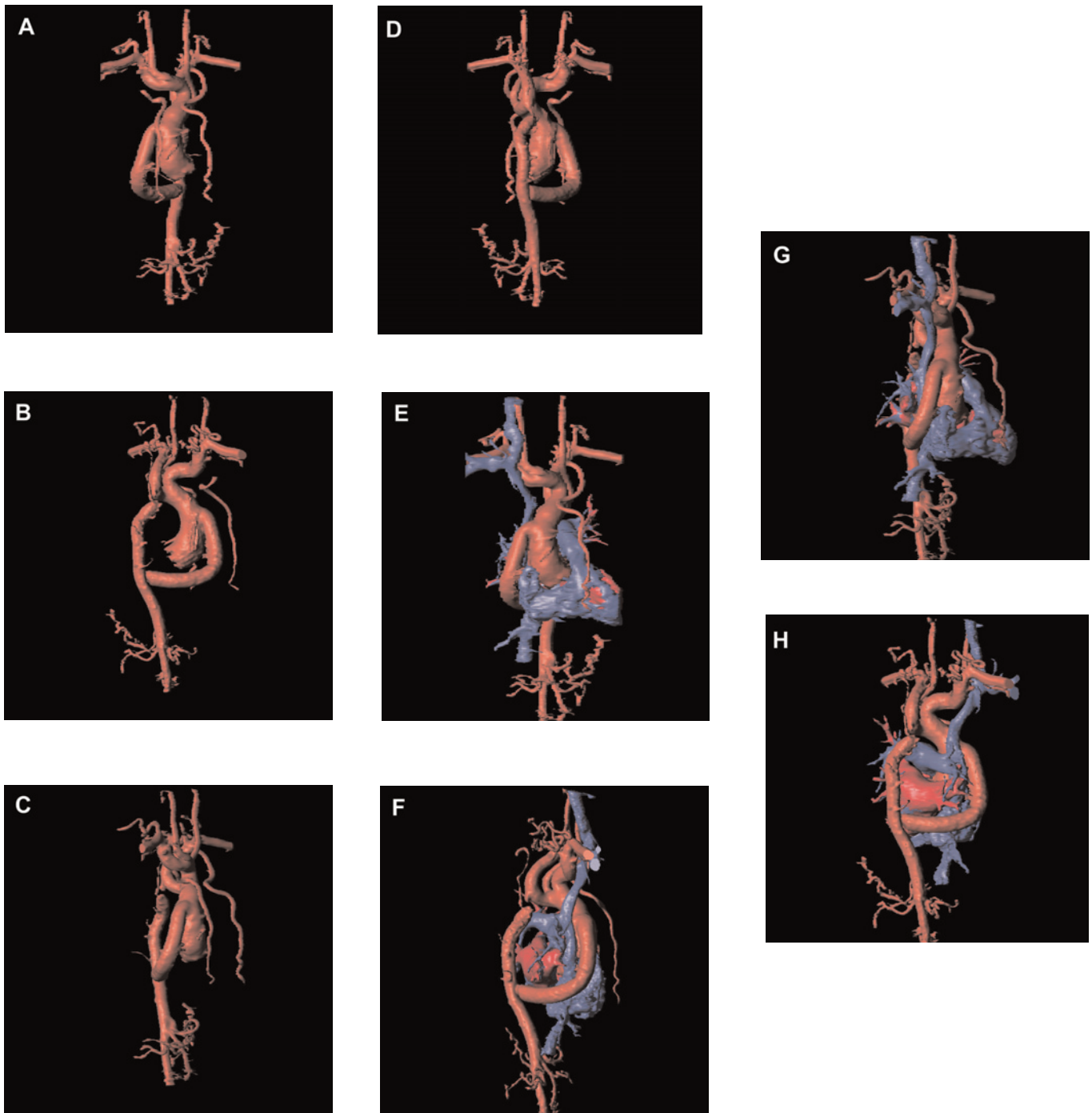


Figure 3. Three-dimensional rendering of contrast-enhanced magnetic resonance angiography showing extraanatomical bypass from the ascending to the descending aorta from anterior (A), right lateral (B), anterior/right lateral (C), and posterior (D) views. E through H, Same projections with additional rendering of the right atrium and right ventricle (blue).

DISCUSSION

An interrupted aortic arch accompanied by further surgical reparable cardiac lesions is a rare combination in adult patients. A simultaneous operative approach to treat both interrupted arch and additional cardiac diseases via a median

sternotomy appears to be advantageous because there is no need for extensive mobilization of the aorta, and complications such as spinal cord injury, damage to the recurrent laryngeal or phrenic nerves, and chylothorax can be avoided. Simultaneous surgery of thoracic aortic coarctations and intracardial pathology in adult patients has been

reported [Vijayanagar 1980]. This approach was modified by Powell and colleagues in that the bypass graft was routed around the right margin of the heart and the proximal anastomosis was placed to the right instead of the left lateral wall of the ascending aorta [Powell 1998]. The placement of the bypass prosthesis between the inferior vena cava and the right inferior pulmonary vein appears to be favorable because the bypass is kept in a posterior location, avoiding compression to the right atrium. Furthermore the risk of bypass injury is avoided in the case of transsternal reoperation [Connolly 2001].

We used a relatively small caliber prosthesis (16 mm) for the descending aorta because the patient's descending aorta was small in caliber (Figure 1). The side-biting clamping of the descending aorta allowed continuation of blood flow to the posterior wall of the aorta and thus to the intercostal arteries, reducing the risk of spinal cord ischemia and paraplegia [Connolly 2001]. In the described case no neurologic abnormalities were observed, in spite of the relatively long perfusion time and aortic cross- and side-clamping times.

Magnetic resonance imaging diagnostic evaluation proved to be an excellent tool for planning surgery as well as postoperative investigation of bypass patency.

We conclude that in the presence of an interrupted aortic arch, extraanatomical bypass between ascending and descending aorta can be performed safely in addition to CABG and AVR through median sternotomy in a single-stage approach.

REFERENCES

- Connolly HM, Schaff HV, Izhar U, Dearani JA, Warnes CA, Orszulak TA. 2001. Posterior pericardial ascending-to-descending aortic bypass: an alternative surgical approach for complex coarctation of the aorta. *Circulation*. 1104(12 suppl 1):I133-7.
- Morris RJ, Samuels LE, Brockman SK. 1998. Total simultaneous repair of coarctation and intracardiac pathology in adult patients. *Ann Thorac Surg* 65(6):1698-702.
- Powell W, Adams P, Cooley D. 1983. Repair of coarctation of the aorta with intracardiac repair. *Tex Heart Inst J* 10:409-13.
- Thomka I, Szedo F, Arvay A. 1997. Repair of coarctation of the aorta in adults with simultaneous aortic valve replacement and coronary artery bypass grafting. *Thorac Cardiovasc Surg* 45:93-6.
- Vijayanagar R, Natarajan P, Eckstein P, et al. 1980. Aortic valvular insufficiency and postductal aortic coarctation in the adult: combined surgical management through median sternotomy: a new surgical approach. *J Thorac Cardiovasc Surg* 79:266-8.

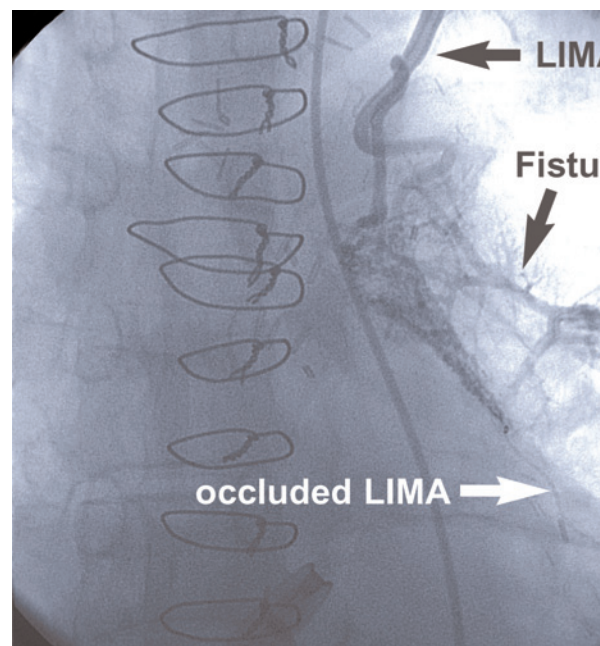


Figure 1. Control angiogram 2 years after surgery showing a left internal mammary artery (LIMA) bypass occlusion and a large fistula deriving from a proximal side branch of the LIMA leading into the pulmonary artery