Type-A acute aortic dissection: combined operation plus stent management
Daniel Roux, Laurent Brouchet, Philippe Concina, Tamer Elghobary, Yves Glock and Gérard Fournial

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://ats.ctsnetjournals.org/cgi/content/full/73/5/1616
Type-A Acute Aortic Dissection: Combined Operation Plus Stent Management

Daniel Roux, MD, Laurent Brouchet, MD, Philippe Concina, MD, Tamer Elghobary, MD, Yves Glock, MD, PhD, and Gérard Fournial, MD

Department of Cardiovascular Surgery, Hôpital de Rangueil, Toulouse, France

When the port of entry of acute type-A aortic dissection is at the level of the horizontal portion of the aortic arch, the latter should be replaced by a prosthesis. To avoid performing this difficult procedure in an emergency situation, we place a stent in the aortic arch. Then we replace the ascending aorta by a prosthesis.


The risk of acute rupture of the ascending aorta in the pericardium justifies urgent intervention for the acute type-A aortic dissection [1]. The classic technique consists of replacing the ascending aorta by using a prosthesis. When the port of entry of the dissection is at the level of the transverse portion of the aortic arch, the classic technique consists of total replacement of the arch by a prosthesis. The procedure then becomes more difficult and the prognosis less favorable [2]. Therefore we performed a procedure that combines the perioperative stenting of the aortic arch and replacement of the ascending aorta by a prosthesis.

Case Reports

Patient 1

A 58-year-old man presented with chest pain and shock. The electrocardiogram was normal. The diagnosis of acute type-A aortic dissection was made from a computed tomographic chest scan. The port of entry was located at the base of the left subclavian artery. The dissection extended distally to the isthmus and proximally into the ascending aorta. The descending thoracic aorta and the abdominal aorta were not affected.

The following procedures were performed as an emergency. The right femoral artery was cannulated (as the arterial line) and the right atrium was also by using a double pore cannula (as the venous line). Cardiopulmonary bypass and profound hypothermia (18°C) were established. During the period of cooling (26 minutes), we positioned the radioscopy apparatus in front of the aortic arch and prepared the device (Fig 1).

The device consists of a stent (Saint Come-Chirurgie; Marseille, France) mounted on a compliant balloon. The stent is made of a Steel 316 L, it is 14 cm long, consisting of three elements each of 4 cm long, and separated from each other by joints of 1 cm each. The stent can be adapted to the shape of the aortic arch [3]. This device has a diameter of 9 mm. A pressure of 220 mm Hg is necessary to open the stent; this pressure can be diminished as the stent opens. When the diameter of the stent reaches approximately 15 mm, a pressure of 160 mm Hg is sufficient to continue its opening.

When the patient’s core temperature reached 18°C, total circulatory arrest was performed. The ascending aorta was resected and the port of entry of the dissection was located. The device was positioned in the arch, and the balloon was inflated with a syringe containing a mix (50/50) of physiologic saline and a contrast. The balloon was inflated under the control of the radioscopy. During this period the assistant was injecting biological glue in the false lumen. We used the port of entry also to inject biological glue further in the false lumen. When the stent was well impacted in the aortic wall and the internal and external cylinders were well coapted, the balloon was deflated. A prosthesis was then sutured to the aorta and its proximal part was clamped.

This prosthesis has a side branch tube that permits a rapid connection with the arterial line of the cardiopulmonary bypass so that the extracorporeal circulation can be continued again in an anterograde manner. The period of total circulatory arrest was 14 minutes. During rewarming, the proximal part of the prosthesis was sutured to the aorta in the supracoronary position (Fig 2). When the core temperature reached 37°C and the hemodynamics were stable, the cardiopulmonary bypass was disconnected.

An immediate postoperative control transesophageal echocardiography was done, which showed the stent in a good position and well opened; it also showed the presence of a thrombosed residual false lumen measuring 4 mm in thickness (Fig 3).

Four months after the operation, a follow-up computed tomographic chest scan was done, which confirmed the good surgical results. The aortic arch was not dilated, there was no circulation in the false lumen, and the stent was in a good position (Fig 4).
Patient 2
A 77-year-old woman presented with characteristic chest pain. The diagnosis was confirmed through transesophageal echocardiography. The port of entry was situated between the left common carotid artery and the left subclavian artery. The dissection extended distally to the isthmus and proximally into the ascending aorta. The descending thoracic aorta and the abdominal aorta were not affected. We performed the same procedure as in the first patient. Total circulatory arrest was 38 minutes. The postoperative control echocardiography and computed tomographic chest scan revealed similar results as those of the first patient.

Comment
Emergency replacement of the aortic arch in acute type A aortic dissection is a high-risk procedure that increases the operative mortality and the postoperative morbidity when compared with simple replacement of the ascending aorta by a prosthesis [4]. This is why we established a combined technique, the positioning of a stent while injecting biological glue in the false lumen permits a good coaptation between the internal and the external cylinders. The 4-mm space, which was mentioned in the postoperative control echocardiography, is filled with the biological glue.

The time of total circulatory arrest is very short (14 minutes) in the first patient, because the stent together with the glue reinforces the aortic wall of the aorta and facilitates the sutures by keeping the lumen always open. In the second patient, total circulatory arrest was longer because the sutures were done by a junior surgeon.

The stent renders the sutures more solidly between the Dacron prosthesis (Saint Come Chirurgie, Marseille, France) and the aorta, which avoids the occurrence of false aneurysm in the site of the anastomosis that sometimes occurs after conventional operations [5].

To avoid retrograde flow in the false lumen through the reentry pathways, which may exist in the abdominal or descending thoracic aorta, we shifted immediately to anterograde flow after total circulatory arrest instead of continued use of the retrograde flow of the femoral artery cannula.

The computed tomographic chest scan 4 months after the operation confirmed the good results. The stent was perfectly applied against the aortic wall, there was no false lumen, and the arch was not dilated.

In these 2 patients, the type A aortic dissection was limited to the aortic arch. This is why the technique has had good results. However, if there are other port of entries in the descending thoracic or abdominal aorta, applying our technique would not be sufficient to obtain good results. That is why we are aiming to apply this technique to the rest of the aorta later on.

References
2. Ando M, Nakajima N, Adachi S, Nakaya M, Kawashima Y. Simultaneous graft replacement of the ascending aorta and
Hybrid Management of Aortic Rupture and Lung Failure: Pumpless Extracorporeal Lung Assist and Endovascular Stent-Graft

Franz X. Schmid, MD, Alois Philipp, MD, Johann Link, MD, Markus Zimmermann, MD, and Dietrich E. Birnbaum, MD

Departments of Cardiothoracic and Vascular Surgery, Diagnostic Radiology, and Anaesthesiology, University of Regensburg, Regensburg, Germany

Acute traumatic aortic rupture represents a potentially life-threatening situation. Because of the extremely high early mortality, emergency surgical repair used to be the preferred method of treatment. This group of patients usually is seen with a wide variety of injuries and comorbid conditions, all of which have a major impact on surgical outcome. We present an alternative hybrid approach that combines on-site placement of pumpless extracorporeal lung assist, subsequent patient transfer, and endovascular stent-graft implantation. This procedure may be a potentially useful strategy to reduce the comorbidity and the mortality of both lesions.


Acute traumatic rupture of the thoracic aorta is mainly a consequence of blunt thoracic or deceleration trauma. Because the majority of these patients are seen with multiple injuries, the most frequent being major fractures, head injury, and blunt thoracic trauma, surgical treatment on an emergency basis has a high mortality rate of 15% to 21% [1]. Given the principle that traumatic aortic injuries are best treated early, defining the strategy for a treatment protocol presents a difficult interdisciplinary challenge.

Accepted for publication Oct 17, 2001.

Address reprint requests to Dr Schmid, Department of Cardiothoracic and Vascular Surgery, University of Regensburg, Franz-Josef-Strauss-Allee 11, D-93053 Regensburg, Germany; e-mail: franz-xaver.schmid@klinik.uni-regensburg.de

© 2002 by The Society of Thoracic Surgeons

Published by Elsevier Science Inc

A 20-year-old man was involved in a head-on car collision. When the emergency physician arrived, the patient was awake and responsive but complained of breathlessness and chest pain. Arterial pressure was stable at 100/60 mm Hg, and heart rate was 112 beats per minute. Because of respiratory deterioration, the patient was intubated and ventilated in the field and transferred to the nearest regional hospital.

The chest radiograph and computed tomographic scan demonstrated bilateral hemopneumothorax with contusional patchy lung disease and rupture of the descending aorta in the isthmic region just distal to the origin of the left subclavian artery (Fig 1A). Despite placement of chest tubes on both sides and maximum ventilatory support, oxygenation deteriorated dramatically; the arterial oxygen tension to inspired oxygen fraction ratio was 36 and the oxygen saturation, 65%. The patient was deemed to be in too unstable condition to undergo transportation or surgical intervention. Consultation by telephone prompted a team of our specialized facility to move to the patient using a rescue helicopter.

Shortly after arrival of the team, extracorporeal lung assist (ECLA) without a pump was initiated (Fig 2). Vascular cannulation was achieved by percutaneous introduction of wire-reinforced heparin sodium–coated cannulas into the right femoral artery and the left femoral vein (model BE-FCSA17V; Jostra AG, Hirrlingen, Germany). The arteriovenous shunt was established by connecting a prefilled membrane oxygenator with low flow resistance (Novabreath; Jostra AG) to the cannulas. Oxygen inflow to the oxygenator was 12 L/min. Technical details of the implantation procedure and the setup have been published previously [2]. The arteriovenous pressure gradient provided an extracorporeal flow across the membrane oxygenator of 2.1 L/min, which represented 25% of the patient’s cardiac output. Oxygen saturation immediately improved to 96%. Cardiac output remained stable at 8 to 10 L/min with moderate inotropic support (dopamine hydrochloride, 20 μg · kg⁻¹ · min⁻¹, and norepinephrine, 5 μg · kg⁻¹ · min⁻¹). A continuous heparin infusion was administered through the arterial cannula to achieve an activated clotting time of 130 to 150 seconds. While receiving extracorporeal support, the patient was transferred to our institution in the rescue helicopter.

The next day oxygenation improved gradually, and the decision was made to perform endovascular stent-graft implantation. Informed consent was obtained from the patient’s parents. After surgical exposure of the arterial access vessel, namely, the left femoral artery, a 5F graduated catheter was positioned in the aortic arch for angiographic evaluation of the false aneurysm and its proximal and distal neck. Subsequently, the introducer system of the stent device was advanced under fluoroscopic guidance. After deployment of the stent at the target position, the leading and trailing parts of the graft were modeled to the aortic wall. Adenosine or other measures to induce bradycardia or to reduce blood flow or pressure were not used, as the highly flexible stent allowed quick delivery of the prosthesis. At completion...
Type-A acute aortic dissection: combined operation plus stent management
Daniel Roux, Laurent Brouchet, Philippe Concina, Tamer Elghobary, Yves Glock and Gérard Fournial