Technical and Procedural Aspects of a Staged Repair of a Giant Post-Dissection Aneurysm by Using Endosizing-Based Endovascular Stenting Following Aortic Surgical Repair with Simultaneous Debranching Technique

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Abstract

We report on a giant aortic post-dissection aneurysm of the ascending and descending aorta that was removed in a staged procedure using debranching technique on extracorporeal circulation and later on treated with endovascular repair using a fitted stent after endosizing.

Keywords: Aortic surgery; Dissection; Debranching; Endosizing; Hybrid endovascular repair; TEVAR

Introduction

Aortic disease is frequently presented by chest pain (75%) or back pain (50%) with abrupt onset (90%), dyspnea and circulatory instability due to shock or tamponade. Hypoperfusion due to true lumen collapse in dissection may affect a variety of organ systems and extremities, e.g. apoplexies (carotid arteries) or acute ischemia of the legs (iliac arteries). At least one pulse deficit is present in one third of patients [1-7]. Because of acute symptoms, patients are immediately admitted to a hospital, but a delay in diagnosis and management of those patients can often be seen in daily practice. In one third of pts., more than 24 hours are lost from symptom onset to diagnosis [7]. After having the correct diagnosis, in Stanford type A dissection, urgent surgical treatment is necessary to avoid further complications or even exitus letalis [1-10]. In type B dissections, without complications like hemorrhagia, hematothorax, medical management of the patient is the treatment of choice (mortality of surgical treatment bears a double mortality of 20%, for medical treatment, 10%) [7].

Case Presentation

Here we report on a Stanford type A dissection with a giant ascending and descending aortic aneurysm (80 mm × 130 mm). A staged procedure with surgical resection of the ascending aortic aneurysm and complete aortic arch resection with debranching was followed by an endovascular stenting of the aortic arch and the residual descending aortic aneurysm. Clinical appearance of this aneurysm did not show typical clinical symptoms. The 62-year-old man with 173 cm of height and 85 kg of weight (BMI 28), who presented himself to a radiologic ambulance four days before Christmas Eve, did not remember a direct or blunt chest trauma nor chest pain with abrupt onset. He reported a kind of retrosternal globus feeling but no kind of pain, no dyspnea or any manifestations of heart failure. There were no leading clinical symptoms. After having initially refused the radiologist’s advice to immediately present him to the nearby cardiac surgical center, later on, the patient gave serious reconsideration to this advice and presented himself four days later on Christmas Eve (Figure 1-4).

Technical report

We evaluated this 80 mm × 130 mm aneurysm of the ascending aorta including a dissection membrane worth for an emergency repair on Christmas Eve. After initiating extracorporeal circulation by cannulating the axillary artery under direct vision and the femoral vein percutaneously, the sternotomy was performed and the aneurysm was exposed (Figure 5). Then the aorta was cross
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clamped, retrograde blood cardioplegia was initiated via coronary sinus perfusion. The partially thrombosed giant aortic aneurysm of nearly 10 cm diameter bearing an old dissection was resected (Figure 6 and 7). The aortic valve appeared competent and the annulus did not show signs of anuloectasia, so that a supra coronary ascending repair was performed. Repair of the dissection of the aortic arch was technically a little bit more demanding. Cardiopulmonary bypass was modified to bilateral selective antegrade cerebral perfusion under moderate hypothermic perfusion (28°C), during distal aortic repair in cardio circulatory arrest. After having resected the aortic arch, debranching of the supra-aortic branches (innominate artery, left common carotid artery, left subclavian artery) was performed (Figure 8). At first sight, the descending aorta did not seem to be reconstructable because of the giant diameter. An approach with the so-called ‘frozen-elephant technique’ using eEvita-Open prosthesis was not applicable because of the diameter. Finally, the adventitia was separated and the false and the right lumina were adapted using
the sandwich-technique with two PTFE-felts that were initially adapted to the inner and outer circumference of the aorta. To this felt- strengthened aortic wall, the 28 mm ostium of a 4-branch graft was anastomosed with a 3-0 prolene running suture (Figure 9). Afterwards, perfusion of the descending aorta was reconstituted via one 10 Fr. branch of the graft that was cannulated separately and connected to the extracorporeal circulation (ECC). After having anastomosed the proximal aorta to the other ostium of the graft, coronary arterial perfusion was restarted and the heart began to beat with a sinus rhythm. The three supra aortic vessels were anastomosed and antegrade perfusion via aorta was reconstituted. Weaning from

Figure 10: POST-OP CT-Scan: sagittal: exclusion of false lumen perfusion.

Figure 11: POST-OP CT-Scan: sagittal: exclusion of the descending aortic aneurysm.
Clinical course

The postoperative course was uneventful. There were no bleeding or neurological neglects so that the patient could be weaned off the respirator and extubated during the following day. He recovered within a few days without signs of malperfusion. A giant dissected aneurysm of the descending aorta remained, so that an additional intervention was necessary. The next step of aortic reconstruction was performed 14d later after reconvalescence of the patient. During this time, sizing of the aorta was performed using EndoSize™ software [THERENVA SAS 2017, Rennes, France]. After having prepared an endostent-graft with an adequate size (Cook Zenith Alpha thoracic) Thoracic Endo Vascular Aortic Repair (TEVAR) was performed via the right femoral artery. The endograft was placed in the new aortic arch with a landing zone distally of the ostium of the left common carotid artery (Figure 10 and 11). Left subclavian artery was still perfused and no endo-leak remained. The distal landing zone was in the middle of the descending aorta (Figure 12-14). The patient recovered without complications and was discharged few days later.

Discussion

Aortic dissections remain a surgical challenge that demands the surgeon’s ability to find the best solution with a certain amount of talent to improvisation. Although the surgical treatment of dissections was established more than 6 decades ago this disease and clinical event still bears a high mortality for the patient [1]. The analysis of the International Registry of Acute Aortic Dissection (IRAD-trial) the type A dissection revealed an overall mortality of 30%, the surgical type A treatment showed 25% and the medical treatment of type A dissection showed a 56% in hospital mortality [6,7]. Even with modern techniques, initial mortality remains high. After surviving the initial trauma (75%), most patients survive the first year (98%). The survival curve declines between 5 (88%) and 10 years (50%) [11,12]. Because of the time-consuming surgical steps within the whole procedure, the surgeon tries to limit the procedures to the very necessary elements of aortic reconstruction. Within this continuum of possible steps, the supracoronary resection and reconstruction of only the ascending aortic is the minimal and fastest step followed by a simultaneous aortic valve replacement, if necessary (e.g. due to calcification or structural valve dysfunction) with Aortic Valve Replacement (AVR) [1,5]. If the procedure remains supracoronary, it is referred to as WHEAT-procedure. If infracoronary, BENTALL- procedure, requiring the coronary ostia’s reimplantation [2,3]. In the case of a structurally intact aortic valve but dilated aortic annulus, a valve sparing procedure can be chosen, it is referred to as DAVID- procedure and the native valve is implanted into the graft prosthesis [8]. The most extensive procedure is the infracoronary reconstruction (DAVID- procedure) with aortic and aortic arch resection with debranching of the supra aortic arteries. A special challenge is the simultaneous reconstruction of aneurysms or dissections of the descending aorta - as presented in this case. Because of the giant dissected aneurysm of the descending aorta, a two-step procedure has to be performed with an endovascular stenting thereafter. TEVAR- sizing is a demanding procedure because the landing zone in the aortic arch must not interfere with the cerebral perfusion via the carotid arteries [9,10]. With regard to other complications, it is important to note that in some studies the prevalence of spinal cord ischemic injury among patients undergoing the frozen elephant trunk procedure ranged from 2.2% to 10.9% [13-16].

Conclusion

We could demonstrate that sophisticated software is able to produce the warranted measures. Other alternatives like the frozen elephant technique with a blind intraoperative placement of a stented graft, i.e. stent placement without knowledge of the anatomical conditions, bear some risk of perfusion deficits and neurological defects like paraplegia. The staged procedure could help this patient to recover without neurological or other complications. With TEVAR- technique, survival of those patients can be optimized and complications, pain and a longer hospital stay can be avoided.

References
