Case Report

Aortic aneurysms and trans-apical endovascular repair in high risk heart transplant recipient, one year follow up

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Abstract: Aortic aneurysms cause major morbidities and mortalities. Operative intervention in ascending aneurysms and dissections is the treatment of choice although there is the risk of major complications because of technical difficulties, late diagnoses, affected hemodynamic and organ mal perfusion. Improved survival of heart transplant (HTx) recipients, acceptance of older donors with co morbidities and advances in HTx give rise to new pathological challenges in the cardiovascular field. Only a few articles have been reported about cardiac and aorta surgery in HTx recipients. Endovascular treatment for aortic pathology in zone 0 is an emerging treatment option. We report the first trans-apical endovascular ascending aorta repair (EVAR) in a 26-year-old HTx recipient, with the history of mediastinitis and lack of femoral access. She had an uneventful operative and post-operative EVAR course.

Keywords: Aneurysm; endovascular; aorta; endovascular ascending aorta repair (EVAR)

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Introduction

Endovascular repair has become the golden treatment option for high risk patients with thoracic and abdominal aneurysms specially in re-do procedures. The ascending aorta and aortic arch pose specific challenges to endovascular approaches because of the origin of supra-aortic trunks, hemodynamic forces, respiratory motion, angulations of the inner aortic curvature and proximity to the coronary arteries and aortic valve (1). The anatomical complexities of ascending aorta and windsock phenomenon make endovascular ascending aorta repair (EVAR) challenging and may cause stent graft specific complications as distal migration, endoleak, stent fracture, kinking, aneurysm rupture or procedure related complications such as stroke, paraplegia, cardiovascular events, respiratory failure, renal failure, intestinal ischemia, and reoperations.

Case presentation

A 26-year-old woman with no previous co-morbidity or risk factors developed uncontrollable idiopathic ventricular fibrillations on the forth post-partum day. Cardiopulmonary support (CPS) was instituted for a week. Two days after being weaned from CPS, she suffered from new events of Life-threatening ventricular tachycardia and fibrillations. Mechanical circulation was reinstituted. She developed gastrointestinal bleeding which was controlled by coiling of colon arteries. While being on CPS for three more weeks, the patient underwent heart transplantation. Post operative period was complicated by mediastinitis, sternum infection, groin wound infection, sepsis, renal failure, pneumonia and respiratory insufficiency. She was treated by multiple surgical interventions for mediastinitis, groin infection, and sudden femoral artery bleeding. She recovered and was discharged from the hospital after four months. Fifteen months later, control CT scan revealed a 46 mm × 23 mm succulent aorta aneurysm close to the right pulmonary artery and superior vena cava (SVC) (*Figures 1,2*) (2). SVC was stented because of the development of SVC syndrome. The rapid enlargement of aneurysm to 46 mm during three months indicated intervention. Due to her

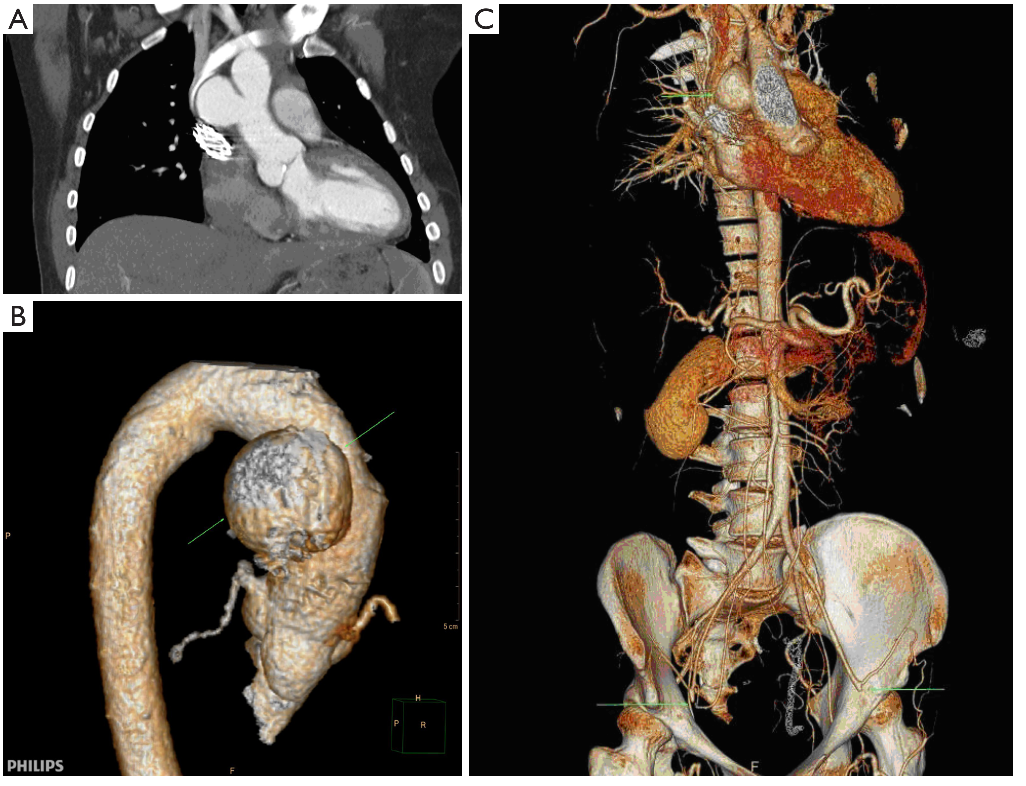

Figure 1 (A) CT scan reveals progressive succulent aneurysm and stented superior vena cava; (B) CT scan shows coronary artery in relation to ascending aneurysm; (C) the arrow shows ascending aneurysm compressing the right pulmonary artery and superior vena cava. Femoral arteries are lacking.

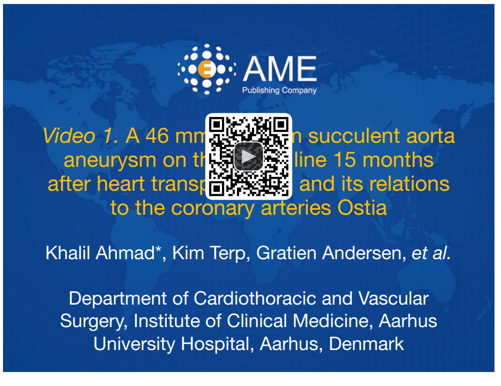

Figure 2 A 46 mm × 23 mm succulent aorta aneurysm on the suture line 15 months after heart transplantation and its relations to the coronary arteries Ostia (2).
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comorbidities and previous complications, open repair approach was considered high risk. We used a custom made investigational ascending aortic stent graft identical in specification to Zenith Ascend Endovascular Graft (ZAEG) to find a safe solution for the treatment of the ascending aortic aneurysm (*Figures 3,4*) (3).

We performed detailed imaging analysis, including 3-D CT scan, obtained aortic branch vessel diameter measurements at multiple landmarks and took length measurements from the highest coronary artery ostia to the origin of brachiocephalic artery along the 3 paths such as the greater curvature, the central line of flow and the lesser curvature. Transfemoral and common carotid artery approaches were not possible. The procedure was performed in a Hybrid operating room under endotracheal anaesthesia and transesophageal echocardiography. The cardiac perfusion team was on stand-by. Axillary/subclavian approach would be used to go on CPS if necessary. Diagnostic aortography of the ascending aorta was performed through the right brachial artery to demonstrate the sinuses and ostia of the coronary and innominate arteries. The patient was systemically heparinised. A small left anterior thoracotomy, followed by pericardiotomy was performed to expose the left ventricular apex. Pursestring sutures were placed on the

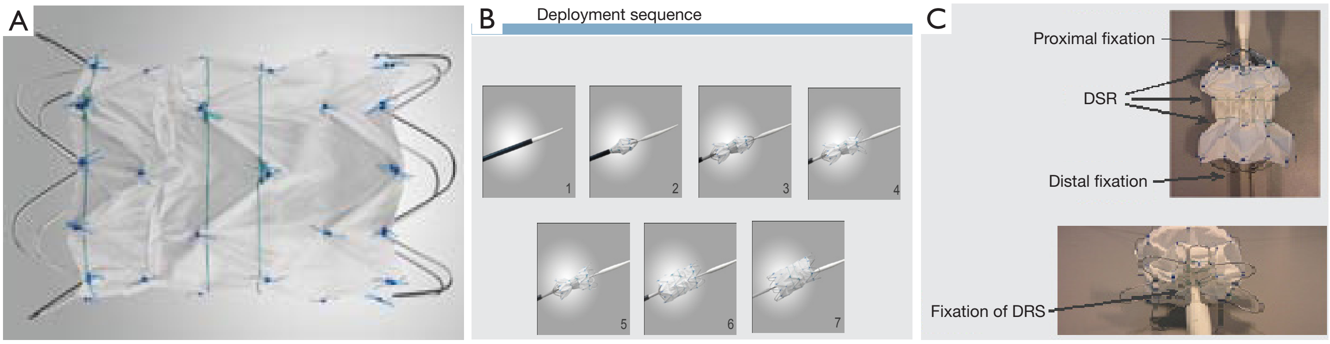

Figure 3 (A) Zenith Ascend Endovascular Graft (ZAEG), designed by Cook Medical Europe, Bjaeverskov, Denmark, consists of a one piece cylindrical graft constructed of woven polyester fabric sewn to self expanding nitinol stents with braided polyester and monofilament polypropylene suture; (B) ZAEG is preloaded onto the Z-Trak Plus Introduction System, which has a soft and flexible tip to decrease ventricular, aortic valve and aortic vessel trauma; (C) proximal and Distal fixation allows for repositioning of the device and the 3× diameter reducing suture (DRS) fixation for deployment accuracy improves deployment accuracy, decreases wind socking and increases stability during deployment.

Figure 4 Demonstrates patent stent in superior vena cava and ascending aorta, patent coronary and innominate arteries with out sign of endoleak, displacement or aneurysm (3).
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apex. The left ventricular apex was punctured between the 2 horizontal 4-0 prolene pursestring sutures by using a 14 gauge needle and the guide wire (cook medical) was advanced to the left ventricle under catheter protection through the ascending aorta and into the aortic arch under echocardiographic and fluoroscopic guidance. Rapid ventricular pacing was performed to minimize pulsatility and distal migration of the endografts during deployment. We deployed two overlapping custom made endovascular stents over the guide wire, (measuring 36±2 and 38±1 mm in diameter, respectively; and each 67±2 mm in length as determined by preoperative CT and angiography under direct fluoroscopic and echocardiography guidance). Post-deployment angiography through the right brachial artery ruled endoleak out, demonstrated a widely patent stent graft, patent coronary and innominate arteries. The apical sutures were secured to achieve haemostasis and finally the minithoracotomy incision was closed. The procedure was uneventful. The patient was extubated in the operating room and was discharged from hospital on the second post-operative day. Control CT scan and echocardiography at 3-, 9-, and 12 months revealed patent stent graft (*Figures 5,6*).

Discussion

Conventional treatment for ascending aortic aneurysm or dissection is open repair requiring sternotomy, cardiopulmonary bypass, deep hypothermic circulatory arrest, and selective cerebral perfusion (4) but some patients bear high risks for this major open intervention due to their comorbidities, anatomical challenges, old age, frail condition or multiple previous interventions. They may benefit from a less invasive alternative called endovascular aortic repair (5). Although there has been great innovations in operative techniques, procedural strategies and intensive care management during the last decades, the mortality rate still remains high (6). The 30-day mortality rate is estimated about 5% to 25% in high volume centres (7) Major complications including stroke, renal failure, prolonged ventilation requirement and reoperations occur in 5-10% of patients after elective conventional repair (7). Vascular disease is a problem in heart transplant (HTx)

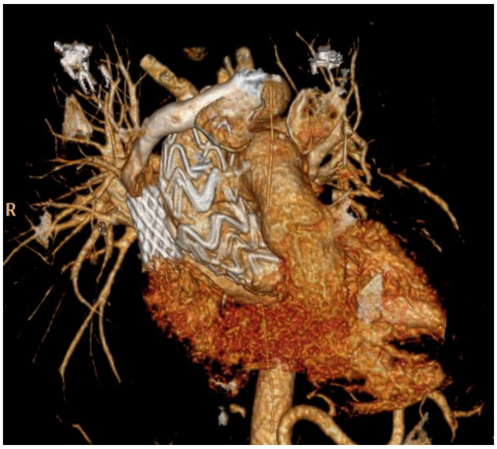

Figure 5 Posterior view: 3-D CT scan reveals stents placed in SVC and ascending aorta. There is no sign of endoleakage.

Figure 6 3-D CT scan nine months after endovascular ascending aorta repair (EVAR) without any displacement or aneurysm.

candidates and recipients. The prevalence is 6% prior to HTx and 12% post-transplant (5). Prevalence of post HTx abdominal aortic aneurysms is 2-10% with a rupture rate during follow up of 11-38% and a mean aneurismal expansion rate of 0.78±0.41 cm/yr (8). Endovascular repair has been widely adopted for treatment of descending aortic pathologies whereas its role in treating aortic arch and ascending aortic pathologies remains undefined and limited (9). The size, shape, hemodynamic forces, and proximity to other vital structures make ascending aorta zone 0 to EVAR. Currently available stent grafts are designed for the descending and abdominal aorta. They do not fully address the unique features of ascending aortic anatomy (10). The ascending aorta is typically broader in diameter than the descending aorta and because it is a curved structure, there is a significant difference in length along the greater and lesser curves. The anatomic feasibility of endovascular repair of type A aortic dissections has been previously assessed (11,12) The inclusion criteria consist of a proximal sealing zone ≥20 mm, true lumen diameter ≤38 mm and total aortic diameter ≤46 mm, absence of coronary artery bypass grafts from the ascending and no grade 3 or 4 regurgitation (11,12) EVAR is an emerging treatment option. However, patients with aorta-coronary bypass, aortic valve insufficiency, lack of proper sealing zone, and those with connective tissue disorders are not candidates for this type of treatment (1). ZAEG, designed by Cook Medical Europe, Bjaeverskov, Denmark, consists of a one piece cylindrical graft constructed of woven polyester fabric sewn to self-expanding nitinol stents with braided polyester and monofilament polypropylene suture. The stent graft is available in diameters ranging from 28 to 46 mm with a total covered length of 65 mm and total stent length of 83 mm including the bare stents (1)

ZAEG is preloaded onto the Z-Trak Plus Introduction System, which has a soft and flexible tip to decrease ventricular, aortic valve and aortic vessel trauma. The anatomical criteria include a minimum 10-mm sealing zone distal to the coronary arteries ostia and proximal to the origin of the innominate artery. The aortic diameter should not be less than 24 mm and greater than 40 mm in size. The long-term performance of endovascular grafts has not yet been established. The patients should be regularly followed-up to assess their health and the performance of their endovascular graft. Vallabhajosyula *et al.* reported a transapical approach to seal the leak in two cases of aortic pseudo aneurysm with no 30 days mortality and no coronary artery or stent graft related complications.

Conclusions

Endovascular repair of ascending aorta is technically possible and can be performed in selected high risk patients including HTx recipients. The ascending aortic endografts are inadequately designed and until improved technology is available only the patients at highest or prohibitive risks should undergo EVAR. Better results may be achieved with an improved design of ascending aorta specific devices and delivery systems.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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