DELAYED TYPE A AORTIC DISSECTION FOLLOWING COMPLETE DEBRANCHING OF THE AORTIC ARCH AND STENT GRAFT PLACEMENT

Odeaa Al Jabbari, M.D.[a]; Walid K. Abu Saleh, M.D.[a]; Ali Irshad, M.D.[a]; Trolls Christensen, M.D.[a]; Brian Bruckner, M.D.[a]; Jean Bismuth, M.D.[a]; Matthias Loebe, M.D., Ph.D.[b]

[a]Houston Methodist DeBakey Heart & Vascular Center, Houston Methodist Hospital, Houston, Texas; [b]Jackson Health System, Miami, Florida

Abstract

Treatment options for aortic arch disease in high-risk patients includes supra-aortic debranching and thoracic endovascular aortic repair (TEVAR). Acute ascending aortic dissection is a concerning complication of this approach and has been reported to occur in a retrograde fashion. We report a case of a 60-year-old gentleman who had undergone thoracic endovascular aortic repair with debranching and presented 31 months later with acute isolated ascending aortic dissection. The patient underwent successful total replacement of the ascending aorta with a 30-mm gelwave Valsalva™ graft using cardiopulmonary bypass.

Introduction

The management of diseases involving the aortic arch and the descending thoracic aorta remain a challenge in cardiovascular surgery.[1] Open surgical approach is the standard method of treatment, which makes use of cardiopulmonary bypass (CPB), hypothermic circulatory arrest, and cerebral perfusion.[1-3] Despite the significant improvement in outcomes, the standard approach continues to be associated with a 15% to 20% mortality rate, according to the U.S. National (Nationwide) Inpatient Sample database. Thus, it is not a suitable option for high-risk surgical patients.[1,2]

Hybrid aortic arch repair has become widely adopted in clinical practice because it is a less invasive technique that combines aortic debranching and thoracic aortic endovascular repair (TEVAR). This approach limits the need to perform a median sternotomy, single-lung ventilation, CBP, and aortic cross-clamp. Moreover, the debranching method provides a healthy and adequate landing zone for the stent graft.[1,2] This technique, however, is associated with its own complications and risks, such as endoleak, paraplegia, stroke, and risk of acute ascending aortic dissection.[1-3] In particular, it is commonly reported that acute aortic dissection can occur in a retrograde fashion shortly after surgery.

Case Presentation

The patient is a 60-year-old gentleman with end-stage renal disease on hemodialysis and a history of aortic arch and descending thoracic aortic dissection. He had previously been treated at another hospital, where he underwent successful off-pump complete supra-aortic arch debranching and GORE TAG endoprosthesis placement in the aortic arch (zone 0) and descending thoracic aorta (Figure 1). The patient had a brief and uncomplicated postoperative hospital course and soon returned to his daily activity. However, 31 months later, he presented to our institution with sudden onset of severe chest pain and an episode of syncope. On examination he was awake and alert but in distress due to severe chest pain. His blood pressure and heart rate were 110/53 and 60, respectively. Computed tomography angiography (CTA) showed acute dissection in the close proximity of the anastomosed debranching graft and extending proximally towards the aortic root. The aortic segment between the proximal end of the stent graft and the debranched anastamosis was free of dissection (Figure 2). Both the innominate artery and the left carotid artery that arise from the ascending aorta were patent and also free of dissection. Left and right coronary arteries were patent with good filling (Figure 3), and the aortic valve appeared to be intact.

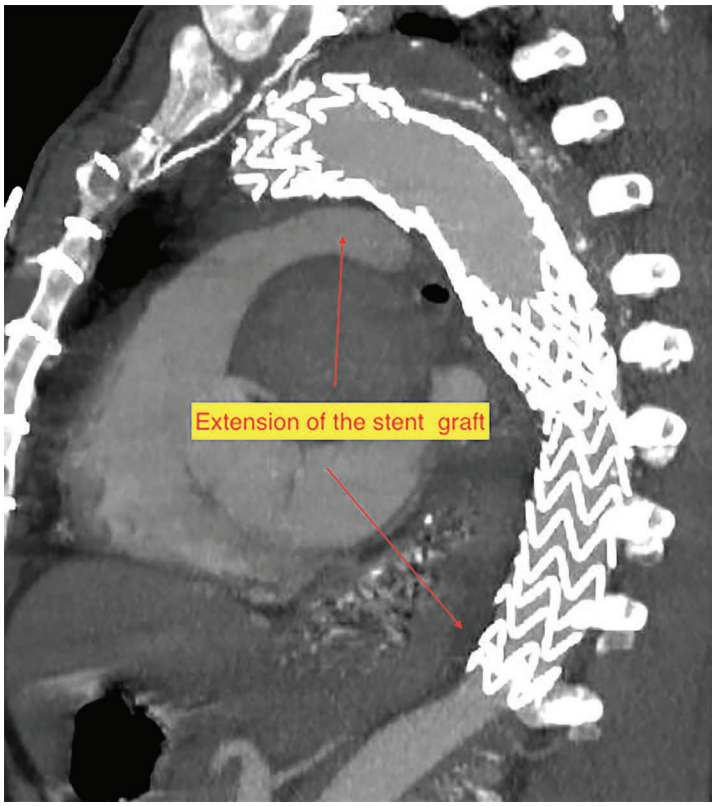

Figure 1. Transverse computed tomography angiography showing the stent graft extending to the diaphragm level.

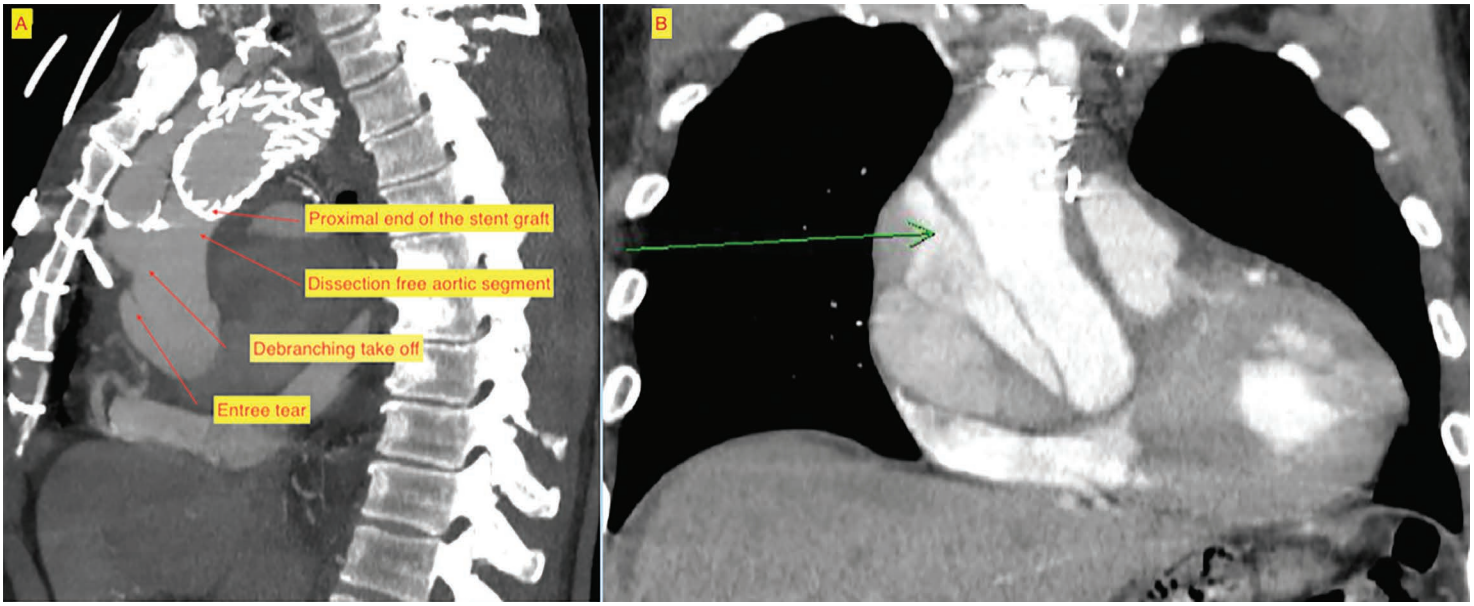

Figure 2. (A) Transverse computed tomography angiography (CTA) showing the dissected segment of the ascending aorta. (B) Sagittal CTA showing the entry tear of the dissection, debranching vessel, and disease-free segment of the aorta between the proximal landing zone and the debranching.

The patient was emergently taken to the operating room, where he underwent median sternotomy, was placed on CPB, cooled to 16°C, and put in complete circulatory arrest. The diseased segment of the ascending aorta was removed, and a 30-mm Gelweave Valsalva™ graft was brought to the field, cut in an angled fashion, then anastomosed to the stent graft and debranched vessels. The aortic root was inspected and repaired with the standard technique using two felt strips and 3-0 prolene suture. Care was taken not to narrow the coronary ostium, and by doing so, the aortic valve was resuspended and the wall was repaired. The graft was then anastomosed to the aortic wall. The patient tolerated the procedure well, was sent to the intensive care unit with temporary chest closure, and returned to the operating room the next day for final closure. Soon after surgery, the patient was weaned off the pressors and eventually extubated. However, he showed continued signs of agitation and confusion that were believed to be caused by an occipital stroke found by CT scan. With further management, the patient continued to recover and was discharge home after 2 weeks.

One year later, the patient is symptom-free and doing well. CTA of the chest and abdomen done 3 months after the surgery showed the stent graft in position and no perigraft fluid collection or endoleak.

Discussion

Since the advent of the hybrid method for treating aortic arch disease, acute ascending aortic dissection has been a concerning complication. In almost all the published reports, acute type A aortic dissections after the hybrid approach occur as an extension of a previously treated dissection (retrograde fashion). Retrograde aortic dissection (RAD) has an estimated incidence of 1.33% to 3.5%[1-3] and predominately occurs in the first month after surgery (70% of cases). Twenty nine percent of RADs occur after the 30-day

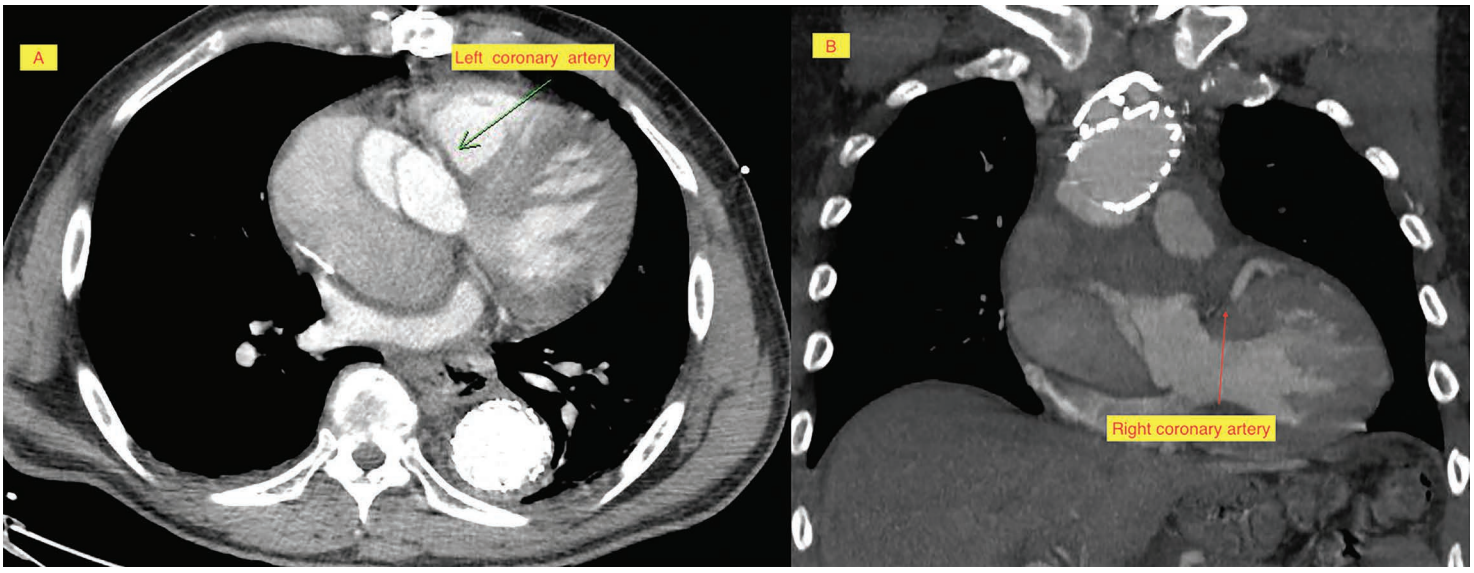

Figure 3. (A) Sagittal computed tomography angiography (CTA) showing the patent right coronary artery. (B) Sagittal CTA showing the patent left coronary artery.

mark, with the majority occurring during the first year. However, a recent report has shown that RAD can occur up to 51 months after surgery.[4-5] The fragility of the ascending aortic wall and stent graft-related factors including an oversized stent, aggressive balloon, and the use of proximal bare stent grafts all may contribute to the incidence of RAD.[4-6]

Iatrogenic intimal injury can also result in RAD and is usually triggered by the partial clamp placement or inadequate intima-to-intima approximation during proximal anastomosis of the debranched graft vessels.[7-9] Iatrogenic ascending aortic dissection occurs more frequently in the presence of other predisposing factors such as atherosclerosis of the aorta, thin dilated aortic walls, cystic medial necrosis, connective tissue disease, and dissection and aneurysm in the adjacent segment of aorta.[7-9] This explains why acute aortic dissection was reported to be a RAD in all previously published reports concerning a hybrid approach complication.

The acute dissection in our case occurred 31 months after surgery, but it was isolated and had no direct connection to the previously treated aortic arch dissection. The acute dissection seemed to have originated from the site of debranching and extended proximally toward the aortic root, leaving the aortic segment between proximal landing zone of the stent graft and the debranched vessels free of dissection.

Uncontrolled hypertension is a major risk factor in the occurrence of aortic clamp trauma, and while CPB used in open aortic surgery allows a temporary decrease in arterial pressure during clamping, it is not used during the hybrid approach. Thus, lateral clamping may be hazardous when patient blood pressure is not lowered to a safer threshold.[5,7] Although isolated abdominal aortic dissection (IAAD) is well recognized in off-pump coronary artery bypass surgeries, to the best of our knowledge it has never been reported following hybrid aortic arch repair and requires further study and reporting.[1,4]

Acute dissection of the ascending aorta is a highly fatal condition with an expected incidence of 2.9% to 3.5 %. Without appropriate intervention within the first 48 hours, the mortality rate increases from 1% to 50%. Therefore, management of this complication requires urgent open surgical repair.[5]

Conclusion

The hybrid approach is a viable treatment option for the management of aortic arch and descending thoracic aortic dissections. It is crucial that physicians have a high index of suspicion for type A dissections after surgery since this complication, although occurring infrequently, is associated with high mortality. Therefore, close lifelong surveillance is recommended. Preoperative assessment of the ascending aorta is necessary to identify patients who are at risk of IAAD. Moreover, during a side-clamping maneuver, adequate control of arterial pressure is recommended as this will minimize the risk of aortic trauma.

Conflict of Interest Disclosure: The author has completed and submitted the *Methodist DeBakey Cardiovascular Journal* Conflict of Interest Statement and none were reported.

Keywords: thoracic endovascular aortic repair, type A aortic dissection, complicated type B aortic dissection, aortic arch debranching

References

1. Geisbusch P, Kotelis D, Muller-Eschner M, Hyhlik-Durr A, Bockler D. Complications after aortic arch hybrid repair. J Vasc Surg. 2011 Apr;53(4):935-41.
2. De Rango P, Cao P, Ferrer C, et al. Aortic arch debranching and thoracic endovascular repair. J Vasc Surg. 2014 Jan;59(1):107-14.
3. Cochennec F, Tresson P, Cross J, Desgranges P, Allaire E, Becquemin JP. Hybrid repair of aortic arch dissections. J Vasc Surg. 2013 Jun;57(6):1560-7.
4. Stanger O, Oberwalder P, Dacar D, Knez I, Rigler B. Late dissection of the ascending aorta after previous cardiac surgery: risk, presentation and outcome. Eur J Cardiothorac Surg. 2002 Mar;21(3):453-8.
5. Manetta F, Ajakaiye B, Scheinerman SJ, Yu PJ. Case Report and Review of Literature: Late Retrograde Type A Aortic Dissection With Rupture after Repair of Type B Aortic Dissection with a GORE TAG Endovascular Prosthesis. Int J Angiol. 2014 Jun;23(2):147-50.
6. Canaud L, Ozdemir BA, Patterson BO, Holt PJ, Loftus IM, Thompson MM. Retrograde aortic dissection after thoracic endovascular aortic repair. Ann Surg. 2014 Aug;260(2):389-95.
7. Chavanon O, Carrier M, Cartier R, Hébert Y, Pellerin M, Pagé P. Increased incidence of acute ascending aortic dissection with off-pump aortocoronary bypass surgery? Ann Thorac Surg. 2001 Feb;71(1):117-21.
8. Narayan P, Angelini GD, Bryan AJ. Iatrogenic intraoperative type A aortic dissection following cardiac surgery. Asian Cardiovasc Thorac Ann. 2015 Jan;23(1):31-5.
9. Rylski B, Hoffmann I, Beyersdorf F, et al. Iatrogenic acute aortic dissection type A: insight from the German Registry for Acute Aortic Dissection Type A (GERAADA). Eur J Cardiothorac Surg. 2013 Aug;44(2):353-9; discussion 359.