Case Report

Acute Type A Aortic Dissection Successfully Managed with One-stage Surgery of Total Aortic Arch Replacement with Supra-aortic Transposition Plus Frozen Elephant Trunk Technique

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SUMMARY

Acute type A aortic dissection has long been a challenging issue. The surgical techniques traditionally vary with the anatomic extent of the aortic dissection. Simple ascending aortic grafting can be lifesaving, but the lesions beyond the aorta, which include the arch vessels and descending aorta, remain potential hazards. In this paper, we present a patient in which acute type A aortic dissection with lesions extending into descending thoracic aorta was successfully managed by total arch replacement with supra-aortic transposition plus the frozen elephant trunk technique to the descending aorta. A 67-year-old gentleman presented with severe tearing pain from the anterior to posterior chest. Computed tomography confirmed the diagnosis of acute type A dissection extending to the level of the right common iliac artery. An emergent operation was performed as in the aforementioned technique. The surgery went well and the patient was discharged without comorbidities on postoperative day 25. The patient had regular outpatient clinical follow-up. The follow-up computed tomography images showed adequate results with the obliteration of the false lumen. In conclusion, total aortic arch replacement with supra-aortic transposition plus frozen elephant trunk technique is a safe and feasible operative method for patients with detrimental acute type A aortic dissection.

1. Introduction

Acute type A dissection has long been a challenging issue for young and elderly patients. One study has shown a difference between young and elderly cohorts with respect to etiology, demographics, comorbidities, and clinical features. Regarding etiology, Marfan syndrome-related type A dissections occur exclusively in young patients, whereas hypertension, atherosclerosis, prior aortic aneurysms, and iatrogenic dissections occur more frequently in elderly patients. Clinical presentations of aortic dissection tend to be atypical in the elderly group. The abrupt onset of a tearing chest or back pain, pulse deficits, or a murmur due to aortic regurgitation occurs less frequently in the elderly. Such features may delay an accurate diagnosis of dissection in this group. Therefore, physicians should be more aware of such atypical presentations when an elderly patient is suspected of having an acute aortic dissection.

A history of hypertension, which is considered the most common predisposing factor for aortic dissection, was present in more than 70% of patients, which is also true for elderly patients. In Taiwan in a nationwide survey, the overall prevalence of hypertension was estimated to be >20% of the population. The prevalence was >50% among elderly individuals (i.e., an age of ≥65 years). Furthermore, the prevalence of receiving treatment and the control of hypertension are relatively low. In the elderly population, hypertension was controlled in only 33.7% of men and 32.8% of women who were treated with medication. All of these facts therefore contribute to the finding that elderly people are more prone to the development of this serious disease entity.

The goal of treatment traditionally is to ensure patient survival and hence ascending aortic grafting is performed in most patients.

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However, the lesions beyond the replaced aortic segment still pose a critical danger. The involvement of the arch vessels can theoretically lead to stroke or coma, and extension into the distal aorta can lead to aneurysm degeneration, which may necessitate future reoperation. Therefore, total arch replacement with supra-aortic transposition plus the frozen elephant trunk (FET) technique was developed to improve long-term outcome. In this article, we present a patient in whom acute type A dissection with lesions extending into the descending thoracic aorta was successfully managed with this novel technique.

2. Case Report

A 67-year-old man with a history of underlying hypertension presented to the emergency room with acute tearing pain from the anterior chest to the back. Physical examination revealed blood pressure of 93/31 mmHg, heart rate of 59 beats/minute, respiratory rate of 19 breaths/minute, and temperature of 37°C. There was no significant difference in the blood pressure measurement at the four limbs. Myocardial infarction was ruled out because of the lack of changes in the cardiac enzyme levels and no ischemic evidence on electrocardiogram. The chest X-ray image showed a widened mediastinum. Aortic dissection was suspected. Computed tomography (CT) confirmed the diagnosis of acute type A aortic dissection (Fig. 1). An emergent operation was performed.

Prior to commencing the cardiopulmonary bypass, an end-to-side anastomosis was performed on the brachiocephalic trunk with a 10 mm Hemashield graft (Maquet Cardiovascular, LLC, Wayne, NJ, USA). Aortic cannulation was performed on a 10-mm Hemashield graft (Maquet Cardiovascular) that was pre-anastomosed to the right axillary artery. During the cooling phase, debranching of the left common carotid artery (LCCA) and left subclavian artery (LSCA) with two 8-mm IMPRA grafts (Bard Peripheral Vascular, Inc., Tempe, AZ, USA) was performed in an end-to-side fashion. Both grafts were then anastomosed end-to-side to the 10-mm Hemashield graft. After clamping the proximal brachiocephalic trunk, deep hypothermic circulatory arrest was performed at 18°C with selective antegrade cerebral perfusion from the right axillary artery. The ascending aorta was transected to the proximal arch. The primary intimal tear was inspected at the proximal descending thoracic aorta. Distal anastomosis was performed at the proximal arch with a 24-mm single-branch Hemashield graft. Under direct vision, a 37 mm × 20 cm Gore TAG thoracic stent graft (W. L. Gore and Associates, Flagstaff, AZ, USA) was antegradely deployed into the descending thoracic aorta with the proximal portion anchored to the inner surface of the 24-mm Hemashield graft. Distal whole body antegrade perfusion was then instituted through a side branch of the 24-mm Hemashield graft with rewarming. Each arch vessel was ligated proximally. Aortic valvuloplasty with commissure resuspension was performed. After proximal aortic anastomosis was performed, the 10-mm Hemashield graft (which was anastomosed to the brachiocephalic trunk) was anastomosed onto the 24-mm Hemashield graft in an end-to-side fashion (Fig. 2). The whole duration of cardiopulmonary bypass was 323 minutes and the duration of deep hypothermic circulatory arrest was 57 minutes.

He was extubated on the 1st postoperative day, but was reintubated on the 4th postoperative day because of respiratory failure and pneumonia. After antibiotic treatment and ventilatory support, extubation was reattempted on the 15th postoperative day. The patient had an uneventful convalescent course and was discharged home on the 25th postoperative day. There was no neurological deficit or paraplegia.

One month after the operation, the follow-up CT scan showed a correct arch repair with good exclusion of the intimal tear by the stent graft. The false lumen at the persistent graft level was obliterated completely (Fig. 3). This case report (14MMHIS144) was approved by the Institutional Review Board of the Mackay Memorial Hospital (Taipei, Taiwan).

3. Discussion

Acute type A aortic dissection is a surgical emergency because of the high risk of death from intrapericardial rupture or organ malperfusion. Without surgery, the mortality is reportedly 1.4%/hour in the first 48 hours. Open surgery has conventionally been performed with a mortality rate of 10–20%. Even though surgical treatment can prevent fatal complications and decrease early mortality, late results have been disappointing. Surgical repair is limited to the ascending aorta in most patients. Persistent distal false lumen perfusion occurs in 50–100% of patients with...
ascending aorta replacement. A distal aortic dissection that is not primarily addressed may be responsible for the considerable number of postoperative complications and deaths.\(^6\)

The “standardized” ascending aortic grafting for the more extensive acute type A dissection may leave a patient with a residual “type B” dissection beyond the aortic arch. Because of the fact that the rate of aneurysmal degeneration of the residual thoracic dissection averages 4.1 mm/year\(^8\) and the risk of rupture becomes significant at the maximal diameter of 6 cm\(^9\), it is obvious that patients who undergo ascending aortic grafting only may require further thoracoabdominal interventions.

It is expected that the longterm outcome can be improved by performing an additional procedure to obliterate the residual false lumen in patients with acute type A dissection.\(^10\) Total arch replacement with elephant trunk technique serves this purpose. However, it traditionally requires a second-stage operation and the interval mortality can be as high as 16%.\(^11\) To complete the procedure in one stage, a surgical strategy consisting of the combination of ascending aorta and arch replacement with antegrade descending aortic stent grafting has been applied since the mid-1990s by Kato and colleagues.\(^12\) In 2003, the procedure was named “the frozen elephant trunk” technique by Hans G. Borst.\(^13\) It is a procedure that can be performed through a median sternotomy. It combines the concepts of the elephant trunk principle and endovascular stenting of the distal descending aorta in one operation.

The advantage of this novel technique over the traditional two-stage elephant trunk repair lies in the fact that the stented graft, unlike a conventional elephant trunk prosthesis, can be securely anchored at the desired level, thereby allowing thrombus formation within the space between the graft and the vessel wall. Furthermore, it avoids the wait interval between the two operations and potentially decreases the mortality risks.

Supra-aortic transposition prior to applying the FET technique is also advantageous. A benefit is that the distal anastomosis can be performed proximal to the origin of the LSCA, which avoids the difficulty in performing the distal anastomosis in the descending aorta and decreases the chances of injury to the recurrent laryngeal nerve and phrenic nerve. Furthermore, this procedure facilitates hemostasis of the distal anastomosis.\(^14\)

There are several studies that compare the total aortic arch replacement plus the FET technique with the traditional ascending or hemiarch aortic grafting strategy.\(^10,15,16\) Jakob et al.\(^15\) demonstrated no significant differences with regard to hospital mortality and the postoperative complication rate. However, in the stented group there was a lower false lumen patency rate and lower need for reintervention. In the Pochettino et al.’s series, 75% of patients within the nonstented group similarly had a patent false lumen at the descending thoracic aorta during follow up, compared to only 23% of patients who had stent grafting into the descending aorta. With regard to longterm patient survival, Uchida’s series showed a 5-year survival rate of 95.3% in a stented group, compared to 69% in the nonstented group (p = 0.03). This corresponds to a 5-year thoracic aortic event-free rate of 95.7% in the stented group, compared to a rate of 73% in the nonstented group (p = 0.01).\(^15\) Murzi et al.\(^15\) concluded in their study that this procedure seems to allow early thrombosis of the false lumen and a reduction in late thoracoabdominal aneurysm formation and reoperation rate.

In our opinion, potential reoperation resulting from the extension of the dissecting aneurysm can be reduced by adopting this strategy. Even if the situation necessitates managing the progressing dissection beyond the distal arch, because arch vessel debranching is provided during the initial operation, performing a redo median sternotomy can at least be avoided by placing the stent graft from the femoral artery instead. Therefore, we believe that encouraging longterm outcomes can be obtained with total aortic arch replacement plus the FET technique as the treatment of choice for acute type A aortic dissection.

There are also concerns regarding the application of the FET technique. One primary concern is spinal cord ischemia. It may result from the blockage of spinal cord perfusion because of the blood-tight seal of the stented graft with the descending aortic wall, which occludes multiple intercostal arteries.\(^17\) However, according to Pochettino et al.’s data, there is statistically a similar rate of spinal cord ischemia in the FET group and the traditional group. This may be explained by the preserved blood flow from the LSCA, which contributes to spinal cord perfusion.\(^18\) Intimal damage during antegrade stent graft deployment has recently been reported.\(^18\) This can be detrimental. Therefore, careful manipulation during deployment and proper stent size selection cannot be overemphasized. In addition, the issue of distal embolization, the characteristics of the landing zone that may preclude deployment, and the persistence of re-entries distal to the stent graft are questions that still need an appropriate answer.\(^19\) The mechanical wearing of the stent graft material may also cause morbidity during longterm surveillance, although this has not yet been reported in the literature.

4. Conclusion

Acute type A aortic dissection remains an intractable surgical challenge. In an attempt to improve longterm outcomes, total aortic arch replacement with supra-aortic transposition plus the FET technique can be the choice operative method.

References


