Case report - Aortic and aneurysmal

Combined valve-sparing root replacement and total arch replacement with frozen elephant trunk

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Abstract

We report a case of simultaneous repair of an extensive thoracic aortic aneurysm from the aortic root to the distal aortic arch. A 54-year-old male had annuloaortic ectasia and a transverse aortic and distal arch aneurysm. Aneurysms of the descending aorta and the abdominal aorta were also demonstrated. The patient underwent aortic valve-sparing root reconstruction, replacement of the aortic arch and placement of a frozen elephant trunk stent-graft concomitantly through a median sternotomy incision. Because a complicated procedure was necessary, root reconstruction was performed first and coronary perfusion was resumed. This case suggests that the surgical procedure should be determined on the bases of the situation of thoracic aortic aneurysm and the general condition of the patient. Treatment for extensive diseased aorta from the aortic root to the distal aortic arch is a surgical challenge. Although single-stage repair is one of the options for this condition, it is very invasive. Total arch replacement with the frozen elephant trunk technique is efficacious to exclude distal arch aneurysm or descending aortic aneurysm through median sternotomy. An aortic valve-sparing operation was developed to preserve the native aortic valve function in order to improve the patient’s quality of life. We herein report a case of concomitant total arch replacement using a frozen elephant trunk and aortic valve-sparing operation for extensive thoracic aortic aneurysm.

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Keywords: Aortic arch; Aortic root; Aortic valve repair; Myocardial protection

1. Case report

The patient was a 54-year-old male who had an abnormal shadow on a chest roentgenogram. The patient had a 30-year medical history of hypertension. The computed tomography (CT)-scan of the chest demonstrated an aneurysm of the ascending aorta (60 mm) plus aortic root dilatation (55 mm), an aortic arch aneurysm and a distal aortic arch aneurysm (55 mm) with mild calcification (Fig. 1). Segmental dilatation of the descending aorta (40 mm) and abdominal aorta (35 mm) was observed. Transthoracic echocardiography showed moderate central aortic regurgitation. The left ventricular ejection fraction was 56.6%, and the left ventricular end-diastolic dimension was 63 mm.

Surgery was performed through a median sternotomy. Cardiopulmonary bypass was established via right axillary artery perfusion and bicaval venous drainage. During the cooling, the ascending aorta was clamped and incised. Severe dilatation of the sinuses of Valsalva were observed, but the diameter of the left ventricular outflow was 26 mm.

Because the aortic cusps were of a normal configuration and pliable, aortic valve-sparing operation using David’s reimplantation technique was performed using 24 mm Gelweave Valsalva graft (Vascutek, Terumo Company, Renfrew, UK). Coronary perfusion was re-established through the aortic root graft by a blood flow rate of 250 ml/min. The fibrillating left ventricle was decompressed by a left atrial venting tube, which was inserted from the right upper pulmonary vein. Then the transverse aortic arch was transected at the level of the left subclavian artery under circulatory arrest at a nasopharyngeal temperature of 25 °C, and selective cerebral perfusion was initiated by two separate pumps.

The stent-graft, comprising a 32-mm Z-stent (William Cook Europe ApS, Bjaeverskov, Denmark) covered with 26 mm of ultrathin woven Dacron (Ubejunken, Ube, Japan), was introduced from the surgical field into the descending aorta along the guidewire introduced from the right femoral artery. The length of the elephant trunk graft was 12 cm to land on the non-dilated portion of the descending aorta. The position of the stent-graft was confirmed by transesophageal echocardiography (TEE). The proximal end of the stent-graft was sutured to the aortic stump. A Hemashield branched arch graft 26 mm in size (Maquet GmbH & Co. KG, Rastatt, Germany) was anastomozed to the elephant trunk graft and the distal aortic arch. Perfusion of the lower extremities was resumed.

After reconstruction of the arch branches separately, the aortic root graft and branched graft were anastomozed.

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De-airing of the left heart system was carefully performed through a left atrial vent and aortic root under monitoring by TEE. Weaning from cardiopulmonary bypass was easy. Aortic cross clamp, circulatory arrest and total bypass time were 182 min, 76 min and 311 min, respectively.

The postoperative course was uneventful. The postoperative maximum MB subform of creatinine phosphokinase was 29 U/l (normal range: 0–12 U/l). The endotracheal tube was extubated 15 h after the operation. The postoperative CT-scan showed that the aortic root was in good shape and the frozen elephant trunk graft was in a good position (Fig. 2). Transthoracic echocardiography showed no aortic regurgitation. The patient is doing well two years after his operation, and complete thrombotic occlusion of the distal aortic arch aneurysm has been obtained.

2. Discussion

Combined aortic root reconstruction and aortic arch repair including the distal aortic arch is a surgical challenge. Although aortic root replacement using a valved conduit is the gold standard for the treatment of annuloaortic ectasia, valve-sparing root reconstruction has been established as a beneficial alternative [1, 2]. The advantage of the valve-sparing operation is freedom from the need for anticoagulation. The aortic valve function is competent and durable if skilled hands perform the operation. On the other hand, because this procedure requires prolonged myocardial ischemia, there is concern over perioperative myocardial dysfunction. Reconstruction of the transverse aortic arch at the level of the distal aortic arch also takes time, and further prolongation of the cardiac ischemia may hinder the recovery of cardiac function.

This patient was young and had multiple aneurysms from the aortic root to the abdominal aorta; surgical intervention or endovascular repair on the descending thoracic aorta may be necessary in the future. Therefore, a single-stage repair from the aortic root to the distal arch was preferable. To shorten the cardiac ischemic time, we employed staged coronary perfusion after aortic root reconstruction during selective cerebral perfusion and circulatory arrest of the lower extremities. The aortic arch was reconstructed under ventricular fibrillation. Frozen elephant trunk was efficacious to minimize dissection of the distal arch through a median sternotomy.

The concept of the frozen elephant trunk method was proposed by Usui and colleagues [3]. This procedure resolves the problem of a freely floating graft of elephant trunk, kinking of the elephant trunk graft and incomplete thrombus formation between the graft and the aneurysmal wall. Dissection is minimal through a median sternotomy even for a distal arch aneurysm. However, the incidence of paraplegia is higher than with routine total arch replacement.
In our case, the elephant trunk graft was designed preoperatively from thin-slice CT measurements to land on the normal descending aorta. To assure placement in the appropriate position through the opened aortic arch, we used TEE during delivery. A postoperative CT-scan showed that the stent-graft had been placed at the optimal position in the descending aortic aorta. By achieving this condition, we could easily perform thoracic endovascular arterial reconstruction as a next-step intervention if the descending aorta became enlarged [4]. Staged procedures using endovascular grafting in the treatment of descending thoracic aneurysm may have the potential to reduce morbidity and mortality rate [5].

3. Conclusion

In conclusion, the frozen elephant trunk procedure is beneficial in the reconstruction of extensive aortic disease extending from the aortic root to the descending aorta.

References


