

# Heart transplantation with concomitant reoperative total aortic arch replacement in a patient with end-stage heart failure and chronic aortic arch dissection



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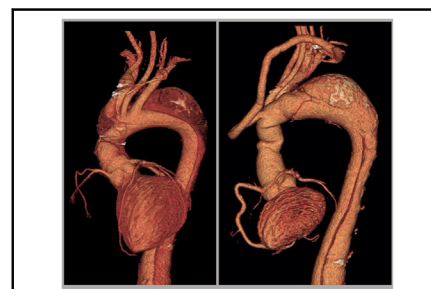
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We describe a 58-year-old male patient who previously underwent aortic valve resuspension with supracoronary ascending aortic and hemiarch replacement in 2011 for an acute Stanford type A aortic dissection. He had residual dissection (Figure 1) involving the innominate artery (IA) with partially thrombosed and aneurysmal false lumen at the transverse arch (5.4 cm). The dissection extended to the iliac bifurcation without malperfusion. In 2017, he was diagnosed with nonischemic, severely dilated cardiomyopathy with heart failure symptoms (New York Heart Association functional class IV<sup>1</sup>) despite maximum medical therapy. He was listed for orthotopic heart transplantation (OHT) as a status 4 candidate. We planned to address his residual arch dissection with total aortic arch replacement (TAAR) at the time his OHT. When a suitable heart became available, consent for publication of this case report was obtained preoperatively. Per Stanford University policy, a case report is exempt from institutional review board approval.

Donor age was 39 years; height -1%; weight +28%; predicted heart mass 0.87; and transport time 3.5 hours. Upon donor heart visualization, the recipient was induced via general anesthesia. Standard heart procurement technique was used.<sup>2</sup> When the donor crossclamp was applied, a small left chest incision was made, exposing the recipient's left axillary artery (LAA), and 2000 units of heparin was given. An 8-mm chimney graft was sewn to the LAA in an end-to-side fashion. This was attached to the cardiopulmonary bypass (CPB) circuit and flushed every 10 minutes.

We proceeded with an uneventful sternal re-entry. After dissection of mediastinal and arch adhesions, systemic

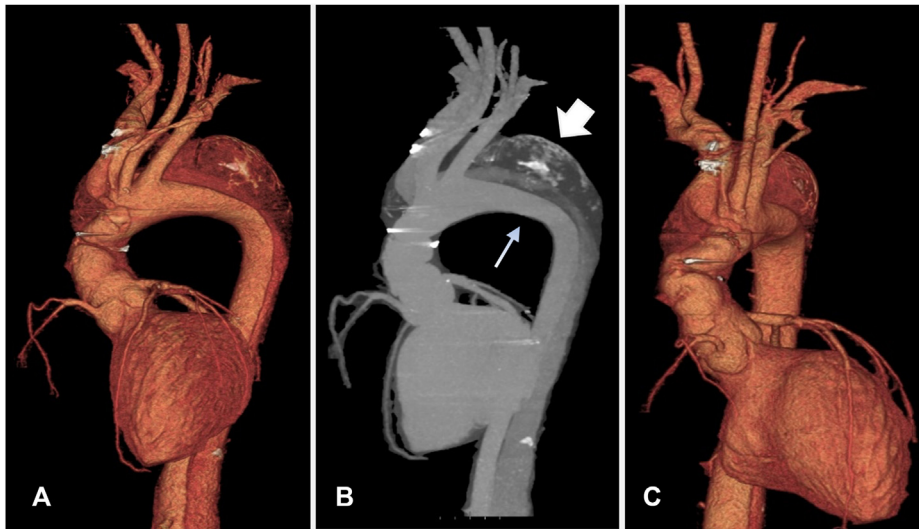


A, Pre- and B, postop CT after heart transplantation with total aortic arch replacement.

## CENTRAL MESSAGE

58-year-old male with previous Stanford type A dissection repair underwent successful redo-sternotomy, total aortic arch replacement, and concomitant orthotopic heart transplantation.

heparin was administered. CPB was initiated via the LAA graft and bicaval venous cannulation. The recipient was cooled to 26 °C. The pre-existing aortic graft was cross-clamped, and the heart explanted. Moderate hypothermic circulatory arrest<sup>3</sup> was initiated via retrograde cerebral perfusion (RCP). The aortic crossclamp was removed, allowing for ease of arch resection. The IA and left common carotid artery (LCCA) were divided. The left subclavian artery was ligated at its origin. Balloon-tip catheters were placed directly into the IA and LCCA to administer cold blood. These along with the LAA graft constituted our selective antegrade cerebral perfusion (SACP) and RCP ended. A septectomy was performed at the distal arch and proximal descending thoracic aorta, connecting the true and false lumens. A 24-mm GelWeave Siena graft (Terumo Aortic) with an elephant trunk extending into the descending thoracic aorta (Figure 2, A) was anastomosed to the aorta. The graft was deaired, clamped, and connected to CPB circuit (bifurcating from the LAA connection) to resume perfusion through the distal arch and left upper extremity. For the best geometric configuration of the graft,

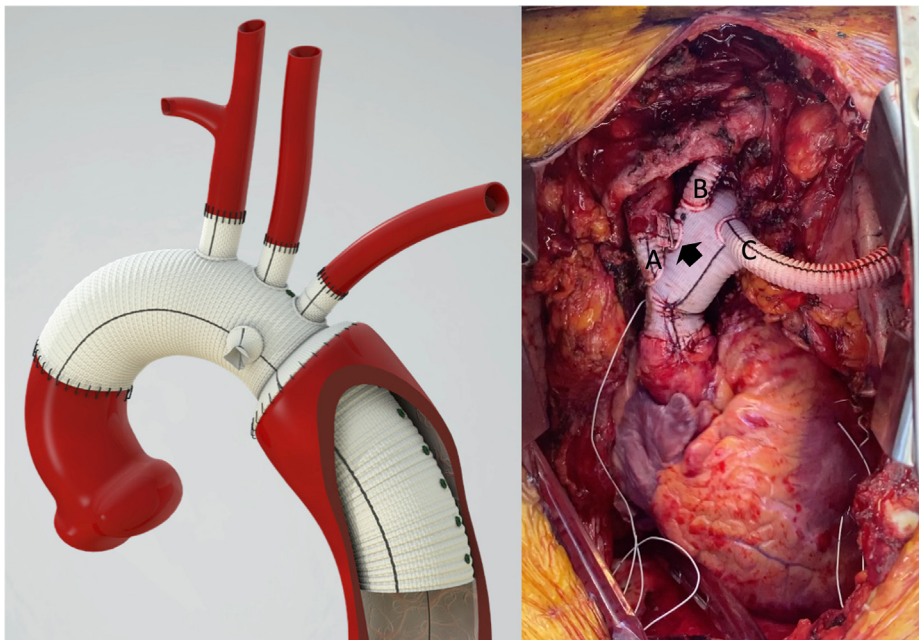


**FIGURE 1.** Preoperative 3-dimensional volume-rendered images showing: A, sagittal projection depicting ascending aortic graft and residual dissection with large false lumen aneurysm; B, differential contrast opacification of true (*thin arrow*) and false (*thick arrow*) lumens; and C, dilated heart (left ventricular diameter 70 mm on transthoracic echocardiogram) and existing ascending aortic graft.

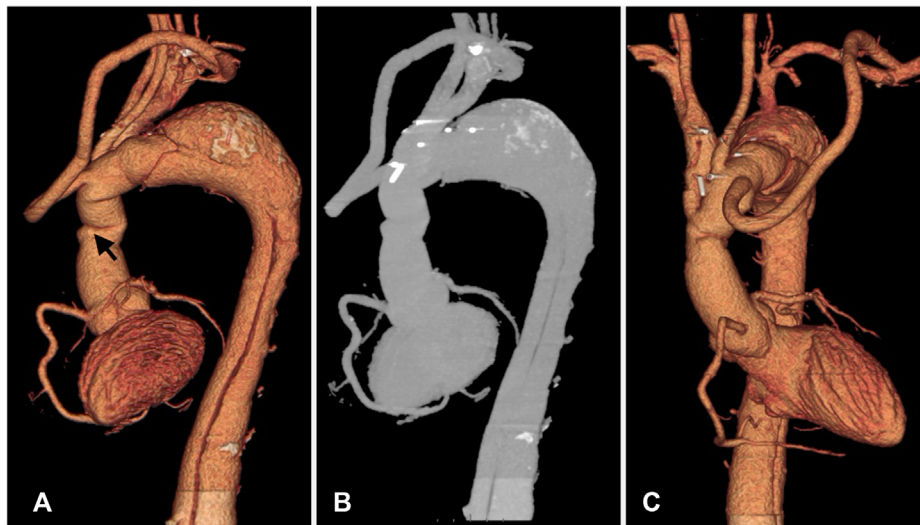
we anastomosed the left subclavian limb to the LCCA, and the IA limb to the IA (**Figure 2, B**). Total systemic reperfusion was now re-established.

As we rewarmed, the donor heart arrived. Standard sequence of OHT anastomoses were performed,<sup>4</sup> beginning with the left atrial cuff, then proximal graft to donor aorta.

Within 30 minutes of donor heart arrival, crossclamp was removed. The pulmonary artery, then inferior and superior vena caval anastomoses, followed. The remaining limb of the graft (perfusion limb) was brought through the chest wall and anastomosed in end-to-end fashion to the now-clamped and shortened LAA chimney graft (**Figure 2, B**).



**FIGURE 2.** Intraoperative image depicting completed total aortic arch replacement with concomitant orthotopic heart transplantation. Image on the *left* shows the GelWeave Siena graft with elephant trunk and its branches in the usual configuration. Image on the *right* depicts our graft configuration. A, Innominate limb to innominate artery. B, Subclavian limb to the left common carotid artery. C, Perfusion limb to the left axillary artery. *Arrowhead* shows the stapled stump of the left carotid limb that was used to connect to cardiopulmonary bypass.



**FIGURE 3.** Patient's postoperative 3-dimensional volume-rendered images following redo sternotomy, total arch replacement, with concomitant orthotopic heart transplantation. A, Sagittal projection showing anastomotic junction (*arrowhead*) of the donor ascending aorta and branched aortic arch graft. B, Symmetric contrast opacification of false and true lumens after aortic arch replacement and false lumen septectomy of the proximal descending thoracic aorta. C, Coronal projection depicting implanted donor heart, patent innominate and left carotid arteries, ligated left subclavian artery, and patent branch graft to the left axillary artery. Distal aortic arch measured 43.2 mm. The proximal descending aorta is 53.1 mm and tapers down to 33.6 mm at the mid descending thoracic aorta.

The patient was easily weaned from CPB. CPB time was 223 minutes; crossclamp: 144 minutes; total allograft time: 258 minutes; warm ischemic time: 17 minutes; RCP: 22 minutes; and SACP: 37 minutes.

The patient was extubated 6 hours postoperatively. Follow-up computed tomography scan at 3 months showed resolution of arch aneurysmal dissection (*Figure 3*). Within 8 months, the patient was able to mountain bike 3 times per week. The elephant trunk will be used for staged intervention of his residual dissection at a later time.

This single surgical team completed a redo-sternotomy and surgical TAAR within a limited—but well-planned—time window to minimize allograft ischemic and total CPB time for the OHT. Performing the recipient cardiectomy first facilitated arch dissection. Combination of RCP and SACP during moderate hypothermic circulatory arrest further expedited the arch resection while maintaining adequate cerebral protection. We used GelWeave Siena graft, rather than donor aortic tissue, to complete the

TAAR while donor heart was in transit. The implantation of donor heart was performed during rewarming. To our knowledge, this is the first report of successful reoperative sternotomy for OHT with concomitant surgical TAAR. This demonstrates that at centers with expertise in both complex aortic surgery and heart transplantation, OHT may be safely performed in patients with complex and challenging aortovascular anatomy.

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