

Transapical thoracic endovascular aortic repair with a frozen elephant trunk for thoracic aortic aneurysm with shaggy aorta



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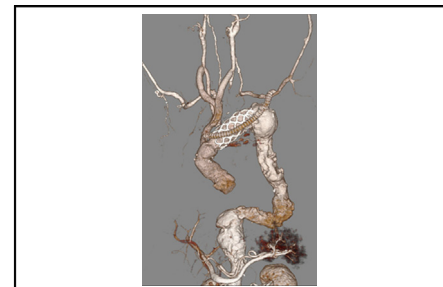
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Thoracic aortic aneurysm with shaggy aorta not removed by previous total arch replacement with frozen elephant trunk.

CENTRAL MESSAGE

Extracorporeal membrane oxygenation–supported transapical thoracic endovascular aortic repair could be a reasonable bailout option for patients with high-risk and unsuitable retrograde access.

See Commentaries on pages 37 and 38.

▶ Video clip is available online.

Surgical repair for thoracic aortic aneurysm (TAA) with shaggy aorta remains challenging due to the risk of cerebral infarction or spinal cord ischemia. Here we report a case of TAA with shaggy aorta successfully treated with transapical endovascular repair under extracorporeal membrane oxygenation (ECMO) support.

The data for this report were collected with the approval of the patient and the Regional Ethics Committee of Asahikawa Medical University (reference no. 19207).

CASE DESCRIPTION

A 64-year-old man presented with a TAA that was 62 mm in outer diameter and had enlarged by 10 mm in 3 months. Including the aneurysm, abundant atherosclerotic plaques forming diffuse ulcers were embedded throughout the aorta (Figure 1, A-D, and Video 1). Despite some comorbidities, including renal dysfunction and chronic obstructive pulmonary disease, we planned graft replacement because thoracic endovascular aortic repair (TEVAR) with the common transfemoral retrograde approach was unsuitable due to the sigmoid-shaped aorta and a high risk of cerebral infarction and spinal cord ischemia owing to shaggy aorta. For further prevention of cerebral embolism, we performed

total debranching hybrid total arch replacement with frozen elephant trunk (FET). In short, total debranching of the bilateral common carotid artery and the left subclavian artery was established using a quadrifurcated graft, and cardiopulmonary bypass was initiated through the fourth branch. Under hypothermic circulatory arrest after the ligation of supra-aortic branches, FET (Frozenix, 31 mm × 120 mm; Japan Lifeline, Tokyo, Japan) was inserted into the aortic arch from the transected ascending aorta (zone 0). Technical details have been described elsewhere.¹

The patient had no perioperative complications; however, despite the preoperative measurement and planning, a computed tomography scan showed that the distal edge of the FET was located in the aneurysm, resulting in incomplete sealing (Figure 2 and Video 2); thus, we planned additional TEVAR. Considering the risks of visceral

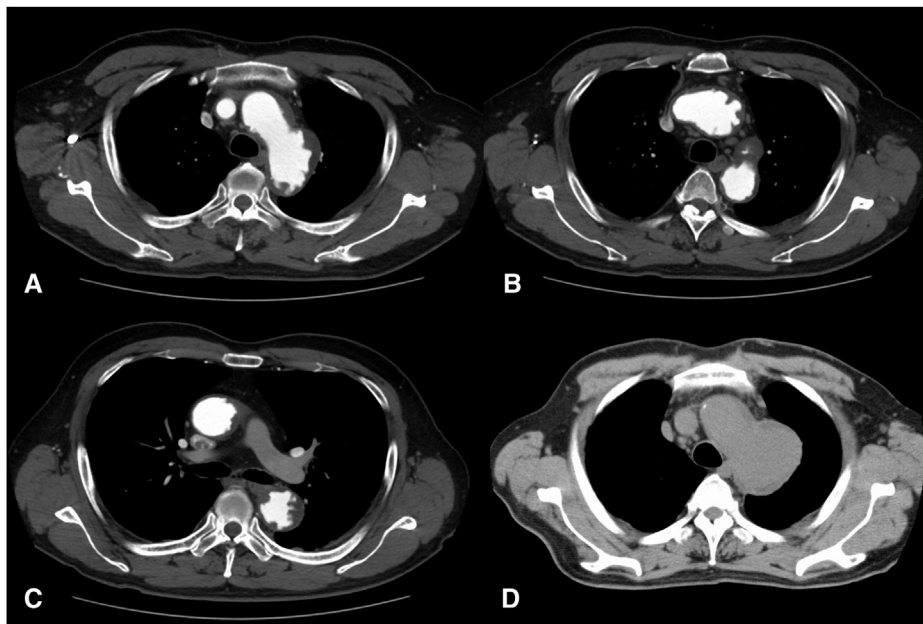


FIGURE 1. Preoperative computed tomography scan showing abundant atherosclerotic plaques forming diffuse ulcers embedded throughout the thoracic aorta (A-C), and the aneurysm located in the distal aortic arch enlarged rapidly within 3 months (D).

thromboembolism and spinal cord ischemia associated with the transfemoral approach, we decided to perform TEVAR with the transapical antegrade approach. We used ECMO to maintain hemodynamic stability, which allowed time for meticulous maneuvers and decision making during TEVAR.

Under general anesthesia, ECMO was established via inflow from the right axillary artery and drainage from the right common femoral vein. Through left lateral thoracotomy in the fifth intercostal space, an 8 Fr sheath and a 0.035-inch guidewire were inserted from the apex, and the

sheath was replaced with a 24 Fr Gore DrySeal sheath (W.L. Gore & Associates, Flagstaff, AZ). Guided by a 0.035-inch stiff wire, a conformable GORE TAG Thoracic Endoprosthesis (34 × 34 × 200 mm) was inserted and deployed into the descending aorta (Video 3). The transapical procedures could be performed under the stabilized setting due to adhesive fixation with the pericardium. Postoperatively, the patient did not experience any complications.

DISCUSSION

A shaggy aorta is an independent risk factor for postoperative complications, such as stroke or bowel necrosis, in both open and endovascular surgical repair for thoracic aortic pathologies.^{2,3} Despite the same risks, open repair is considered favorable, because stroke can be prevented by brain isolation techniques or meticulous insertion of arterial cannulas. In addition, endovascular repair requires catheter maneuvers within the diseased aorta, which may dislodge or shift plaques, causing embolic or mechanical obstruction of visceral and spinal arteries. In the initial surgery of the present case, we could avoid embolic events by using the brain isolation technique.

On the other hand, a novel technique to prevent stroke by brain isolation using ECMO during debranching TEVAR was recently documented.⁴ Furthermore, in cases with unsuitable access, such as severely tortuous or stenotic aorta/iliofemoral artery access, Murakami and colleagues⁵ reported the use of TEVAR via a transapical approach. Referred to these techniques, we performed transapical TEVAR under ECMO support for the remaining aneurysm



VIDEO 1. Computed tomography scan demonstrating abundant atherosclerotic plaques forming diffuse ulcers embedded throughout the aorta. Video available at: [https://www.jtcvs.org/article/S2666-2507\(21\)00281-9/fulltext](https://www.jtcvs.org/article/S2666-2507(21)00281-9/fulltext).

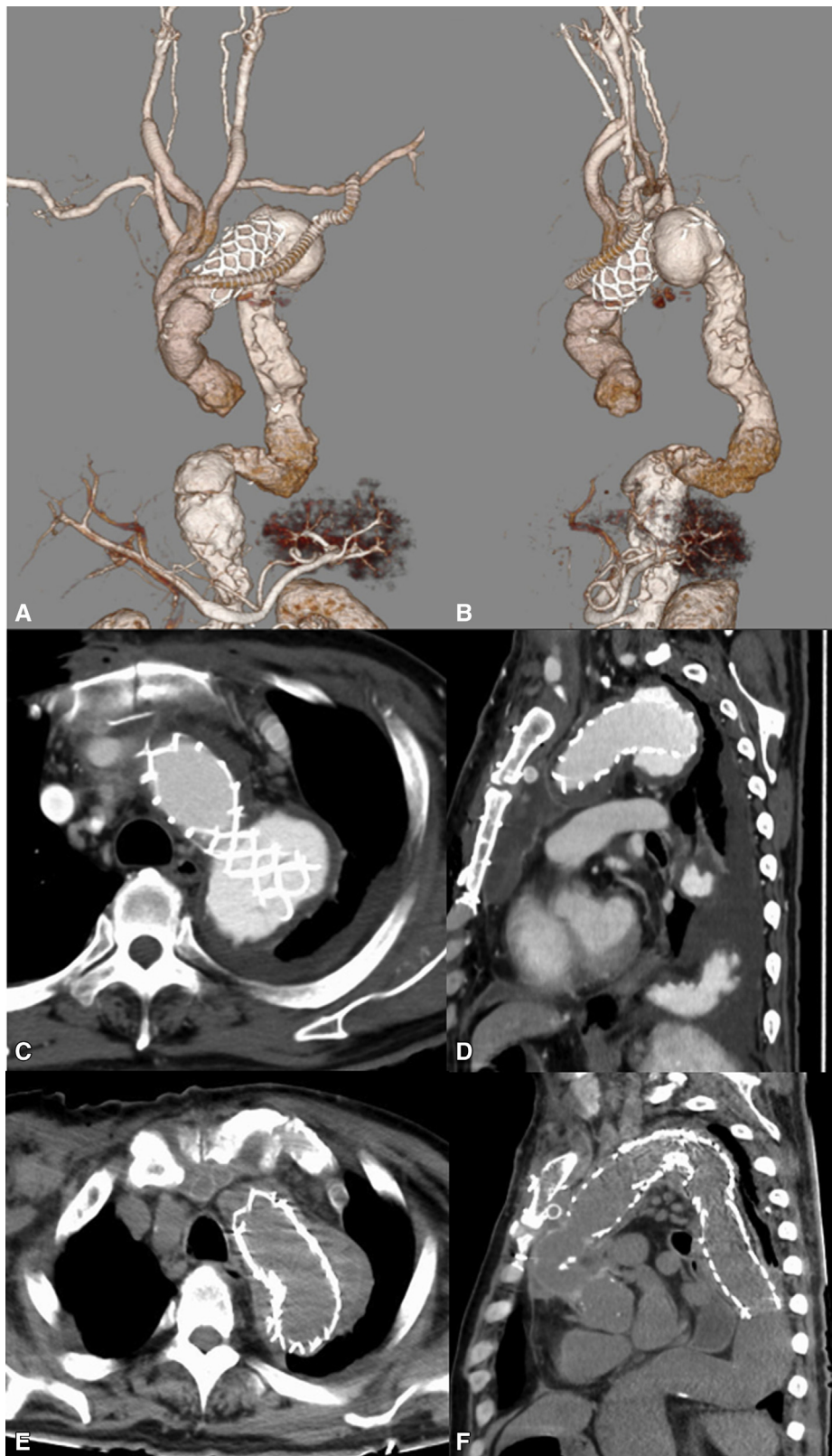
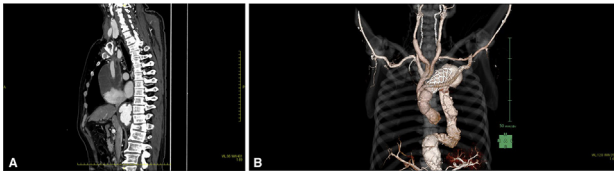


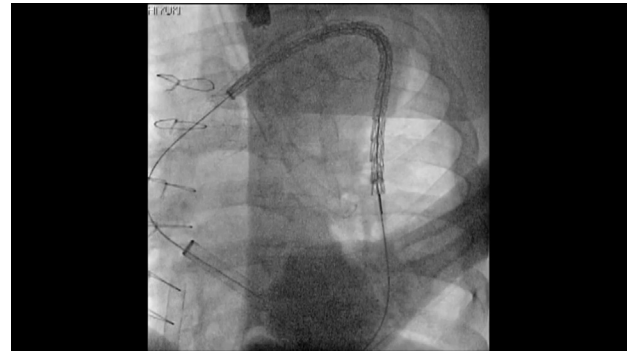
FIGURE 2. The aneurysm was not removed by initial total debranching hybrid total arch replacement with frozen elephant trunk (A-D). Subsequent thoracic endovascular aortic repair via a transapical approach was successfully performed under extracorporeal membrane oxygenation support (E and F).



VIDEO 2. Computed tomography scan after open repair showing the distal edge of the frozen elephant trunk located in the aneurysm, resulting in incomplete sealing. A, Sagittal view. B, Three-dimensional view. Video available at: [https://www.jtcvs.org/article/S2666-2507\(21\)00281-9/fulltext](https://www.jtcvs.org/article/S2666-2507(21)00281-9/fulltext).

successfully. Similar to other cases of debranching TEVAR using ECMO to prevent stroke, we meticulously set the return flow from ECMO to the minimum rate, because excessive flow can dislodge plaque and cause an embolism even toward the proximal, provoking myocardial infarction. We confirmed the flow by aortography and transesophageal echocardiography.

In this case, we might have avoided the subsequent TEVAR with hybrid aortic repair or with a distal anastomosis at zone 1/2. However, this bailout procedure is technically feasible and can be applied to other high-risk cases, including patients with impaired cardiac function or reoperation. Furthermore, TEVAR via a transapical approach may reduce the risk of spinal cord ischemia, because the main body of the stent-graft does not pass through the diseased aorta even though wire manipulation is still required. Further accumulation of cases and refinement of procedures are needed.



VIDEO 3. The stent-graft was delivered with a transapical antegrade approach. Video available at: [https://www.jtcvs.org/article/S2666-2507\(21\)00281-9/fulltext](https://www.jtcvs.org/article/S2666-2507(21)00281-9/fulltext).

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