Right thoracotomy approach for the management of uncommon type II endoleak after thoracic endovascular aortic repair

Yoshiyuki Kobayashi, MD,[a] Keiji Uchida, MD, PhD,[b] Kaori Mori, MD,[a] Kiyotaka Suzuki, MD,[a] *and* Aya Saito, MD, PhD,[a] *Yokohama, Japan*

ABSTRACT

An 80-year-old male with a ruptured pseudoaneurysm after aortic dissection repair underwent thoracic endovascular aneurysm repair. The aneurysm expanded from 43 mm to 89 mm over 4 years because of type II endoleak, with computed tomography angiography revealing a patent right intercostobronchial trunk and left bronchial artery on the lesser curvature of the aortic arch. These arteries were successfully dissected via right thoracotomy. During the 2-year postoperative period, the aneurysm remained stable at 80 mm. Open surgical management of the culprit vessel may be effective for type II endoleaks following thoracic endovascular aneurysm repair when endovascular approaches are challenging. (J Vasc Surg Cases Innov Tech 2025;11:101749.)

Keywords: Acute aortic dissection; Intercostobronchial trunk; Right thoracotomy; Thoracic endovascular aortic repair; Type II endoleak

Type II endoleaks (T2ELs) post-thoracic endovascular aortic repair (TEVAR) occur in approximately 3.3% of cases,[1] typically arising from intercostal or bronchial arteries. It frequently resolves spontaneously or remains clinically insignificant; thus, it is less problematic than post-abdominal endovascular aneurysm repair. However, persistent T2EL leading to aneurysm expansion requires further treatment. Managing such cases can be challenging when the responsible vessels are difficult to access endovascularly.

This case report presents an innovative right thoracotomy approach for directly treating culprit vessels in uncommon T2EL following total arch replacement (TAR) and TEVAR. The patient provided written informed consent for this report's publication, and the study followed our institutional ethical guidelines and the Declaration of Helsinki.

CASE REPORT

An 80-year-old male underwent emergency surgery for acute Stanford type A aortic dissection at another hospital during chronic hemodialysis 6 years earlier. An entry tear distal to the subclavian artery necessitated TAR with a conventional elephant trunk (CET). BioGlue (CryoLife Inc) was applied to the false lumen at the distal anastomotic site in Zone 3. A CET was created using a 20-mm straight graft, and a 24-mm four-branched arch graft was attached to complete TAR. Two years post initial surgery, the patient was transferred to our center with severe hemoptysis and shock. Urgent computed tomography (CT) imaging revealed a rapidly developing pseudoaneurysm measuring 43 mm axially and 54 mm coronally at the distal anastomosis site of the previous TAR, not observed until recent follow-ups. TEVAR with a 31 × 150-mm Conformable GORE TAG Thoracic Endoprosthesis (W. L. Gore & Associates) successfully isolated the pseudoaneurysm. Post-TEVAR, hemoptysis resolved, and the patient was discharged with regular CT follow-ups. Despite the initial success of the procedure and strict blood pressure management, the aneurysm expanded unexpectedly over the subsequent 4 years, leading to readmission. Although hemoptysis caused by the aortobronchial fistula raised infection suspicions, no elevated inflammatory markers in blood tests or imaging findings indicative of infections were observed.

The most recent CT scans demonstrated an aneurysm measuring 89 mm axially and 85 mm coronally, with 9 mm and 5 mm increases, respectively, over the last 4 months. Detailed evaluation revealed the common trunk of the right third and fourth intercostal arteries and right bronchial artery (right intercostobronchial trunk [ICBT], 2.5 mm), running between the esophagus and vertebral body, joining the left bronchial artery (<2 mm) at the root. This configuration, which opened outside the CET on the lesser curvature side of the aorta, was suspected to cause the T2EL (Fig 1).

The primary surgical option was descending aortic replacement via left thoracotomy. However, given the patient's advanced age, hemodialysis dependence, and aortobronchial fistula history, this approach was considered excessively risky owing to excessive adhesions and the potential need for lung resection. The endovascular approach to the culprit vessels was deemed technically unfeasible by interventional

From the Department of Surgery, Yokohama City University Hospital[a]; and the Cardiovascular Center, Yokohama City University Medical Center.[b]

Correspondence: Yoshiyuki Kobayashi, MD, Department of Surgery, Yokohama City University Hospital, 3-9 Fukuura, Kanazawa-ku, Yokohama 236-0004, Japan (e-mail: kobayashi.yos.pm@yokohama-cu.ac.jp).

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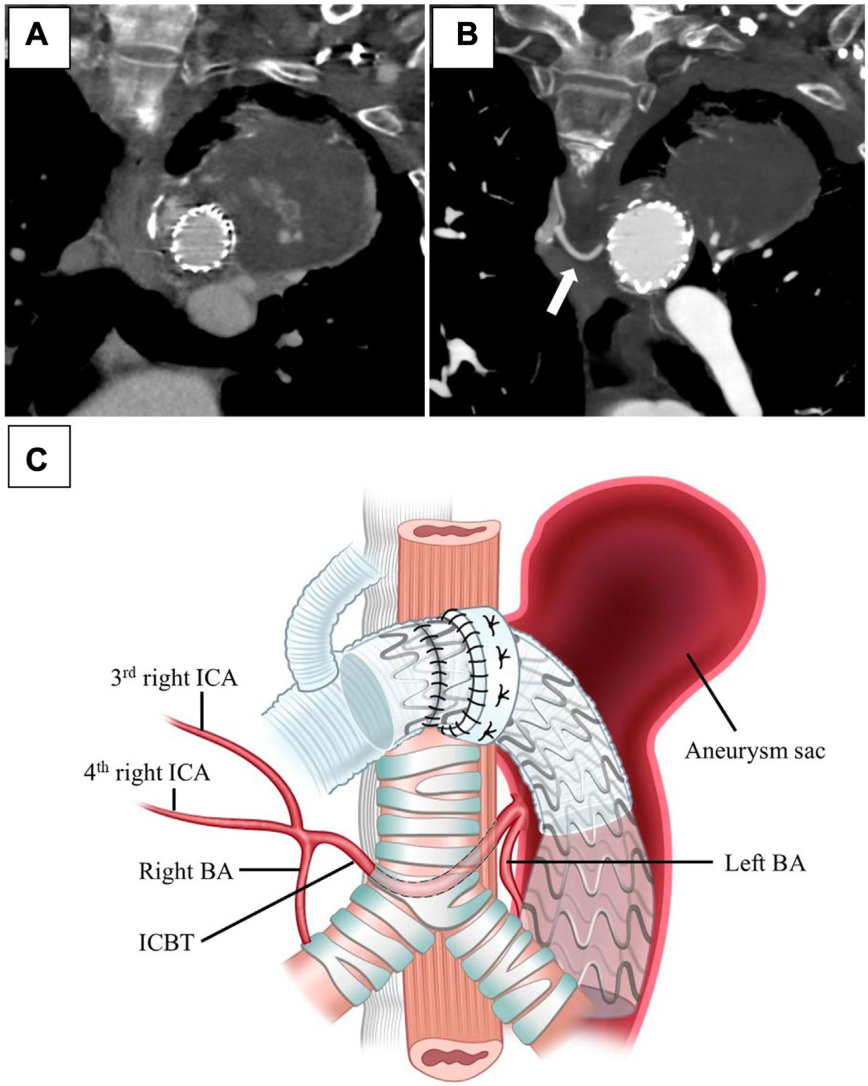

Fig 1. (A) Preoperative computed tomography (CT) scan showing a thoracic aortic aneurysm measuring 89 mm in axial and 85 mm in coronal diameter at the distal aortic arch, with an evident endoleak, particularly along the lesser curvature. **(B)** A patent intercostobronchial trunk (*ICBT*) extends to its origin at the lesser curvature of the aortic arch (*arrow*), indicating direct communication with the aneurysm sac, suggesting the ICBT as the source of the type II endoleak (T2EL). **(C)** Schematic illustration demonstrating the relationship between the ICBT and the aneurysm sac after thoracic endovascular aortic repair (TEVAR) insertion into the prosthetic graft of the aortic arch. The ICBT and left bronchial artery originate from the native aorta between the prosthetic graft and TEVAR stent graft, allowing persistent retrograde flow into the aneurysm sac and resulting in a T2EL. *BA*, Bronchial artery; *ICA*, intercostal artery.

radiologists. Although the thoracoscopic approach was considered, it was avoided due to anticipated severe adhesions and the risk of delayed response to bleeding. After careful evaluation, a right thoracotomy was proposed to directly address the patent ICBT and left bronchial artery.

The procedure was performed under general anesthesia with single-lung ventilation in the left lateral decubitus position. A 15-cm incision was made in the right fourth intercostal space, with an Adams-Yozu minimally invasive cardiac surgery retractor exposure. A thoracoscope was used for magnification and improved lighting. Oxygenation with left single-lung ventilation was challenging, necessitating intermittent bilateral ventilation (Fig 2, *A*). After incising the parietal pleura, the azygos arch was taped, and the right superior intercostal vein was divided to expose the right third and fourth intercostal arteries. Careful dissection traced these vessels to their origin. As the dissection approached the aorta, adhesions became denser. The origin was successfully identified, bifurcating into the ICBT and left bronchial artery, both of which were safely double-clipped and dissected. The procedure lasted 330 minutes with minimal blood loss, and the patient was extubated in the operating room.

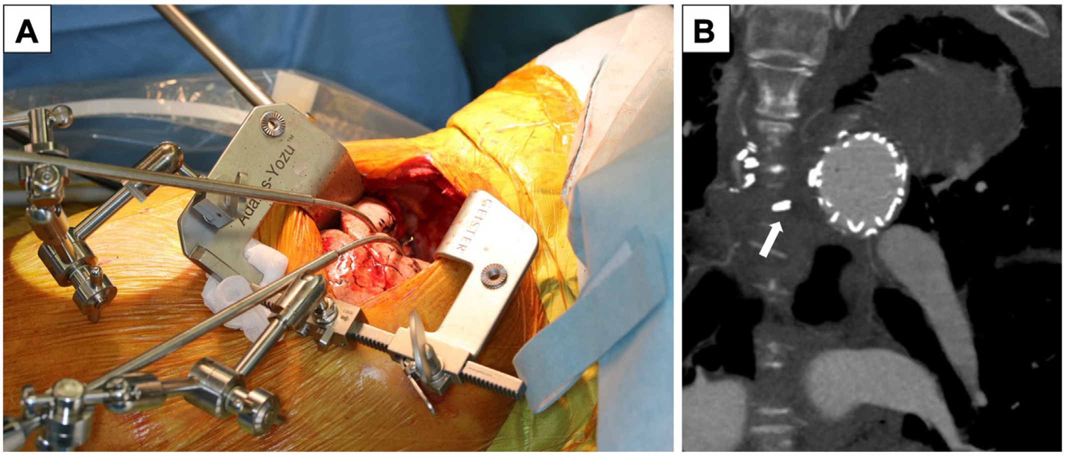

Fig 2. (A) Intraoperative images showing the right thoracotomy approach. The cranial side is to the right of the image, with the surgical field exposed through a fourth intercostal incision. The right lung is retracted caudally using a minimally invasive cardiac surgery mitral valve retractor, ensuring adequate exposure while maintaining bilateral ventilation. **(B)** Successful clip placement on the target vessel, confirmed by a postoperative computed tomography (CT) scan (*arrow*).

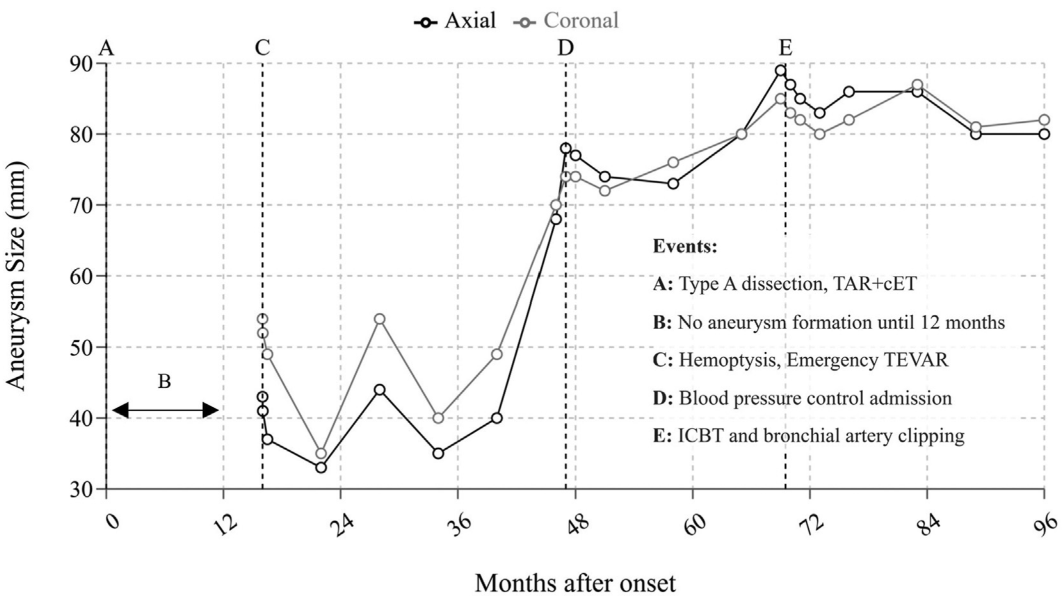

Fig 3. The graph shows the temporal changes in aortic aneurysm diameter as measured by computed tomography (CT). Measurements were consistently taken at the upper edge of the stent graft for axial sections and just distal to the felt strip for coronal sections. All measurements were retrospectively re-evaluated for consistency. *cET*, Conventional elephant trunk; *ICBT*, intercostobronchial trunk; *TAR*, total arch replacement; *TEVAR*, thoracic endovascular aortic repair.

Postoperative CT showed decreased aneurysm size and proper clip placement (Fig 2, *B*). The patient required prolonged chest tube drainage for iatrogenic lung injury from the retractor and rehabilitation for preoperative frailty but was discharged home on postoperative day 27. The aneurysm remained stable at 80 mm axially and 82 mm coronally over 2 years of follow-up (Fig 3).

DISCUSSION

When using the CET technique for acute aortic dissection repair, a straight graft with a smaller diameter than a four-branched arch graft is typically used to mitigate the risk of infolding and kinking within the narrow true lumen of the descending aorta. The distal anastomosis site lacks graft junctions, which minimizes pseudoaneurysm formation risks. Furthermore, the descending aorta showed favorable remodeling post-TAR in this case, making rupture due to false lumen expansion unlikely.

BioGlue, used for reinforcement in acute aortic dissection surgery, is associated with tissue toxicity-induced anastomotic pseudoaneurysm formation.[2] In this case, its application likely contributed to aortic wall degeneration and pseudoaneurysm formation. Theoretically, placing a stent graft with proximal landing in the prosthetic graft and distal landing in the healthy descending aorta should isolate the pseudoaneurysm and prevent expansion. However, the large patent ICBT in the CET region complicated this, and the second-stage stent graft deployed inside the narrow CET failed to close the ICBT, resulting in a persistent T2EL and continued aneurysm growth.

This case highlights the risk of T2EL after TEVAR following CET, a potential issue not widely recognized. Although frozen elephant trunk technique has replaced CET, T2EL still occurs after TAR + frozen elephant trunk, with six reports of 32 cases among 1728 patients (1.9%), excluding identifiable cases from the left subclavian artery.[3-8]

When T2EL causes aneurysm expansion, additional treatment is required. Transcatheter arterial embolization is often the first choice but can be challenging in the thoracic aorta due to poorer collateral vessels than in the abdominal aorta.[9] Karube et al[10] described a direct intercostal artery puncture method for transcatheter arterial embolization by surgically exposing the proximal portions of intercostal arteries, which proved effective for lower intercostal arteries not covered by the scapula. Direct aneurysm puncture, although effective, carries lung injury risk and is limited to cases with a safe puncture window.[9]

The right thoracotomy approach in this case enables direct visualization and secure management of culprit vessels, particularly for upper intercostal and bronchial arteries inaccessible endovascularly. However, it carries risks associated with thoracotomy and postoperative respiratory complications. Although the anterior spinal artery may occasionally originate from the ICBT,[11] the culprit vessel in T2EL exhibits retrograde flow, making ligation at its origin typically low risk for spinal cord ischemia. A comprehensive CT evaluation is essential to confirm anatomy and ensure a safe surgical approach. Care must also be taken to avoid injury to the esophagus and thoracic duct and excessive esophageal dissection that could cause necrosis.

Patent intercostal arteries from the false lumen inhibit thrombosis in chronic type B dissections.[12] Successful cases of intercostal artery embolization with favorable remodeling have been reported,[13,14] including preventive procedures.[15] This approach could apply to non-dissecting aneurysms. Further evaluation is warranted to determine the indications and long-term outcomes of preventive embolization, therapeutic embolization, and open surgery.

Managing T2EL post-TEVAR requires tailored strategies based on individual patient risks and anatomy. The right thoracotomy approach for intercostal and bronchial artery clipping may be effective when endovascular approaches are challenging.

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DISCLOSURES

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