Thoracic endovascular aortic repair (TEVAR) has become the preferred modality for treatment of a wide array of pathologic processes of the descending thoracic aorta, especially in high-risk patients.12 The increasing use of TEVAR in recent years has been associated with recognition of various unusual but fatal complications, such as aortoesophageal fistula (AEF),3-6 which has an incidence ranging from 1.5% to 2.6%.4,5,7,8 This case report presents a technical video of a two-stage open surgical approach to treat the AEF with an extra-anatomic aortic bypass, followed by explantation of the infected endograft. The patient consented to this report.

CASE REPORT

A 71-year-old female active smoker with past medical history of hypertension underwent emergent TEVAR at an outside institution for the treatment of an acute penetrating atherosclerotic aortic ulcer in the descending thoracic aorta that was complicated by a groin wound infection with methicillin-resistant Staphylococcus aureus (MRSA) requiring surgical debridement.

Three months after the index TEVAR procedure, the patient presented to our facility with long-standing melena and a hemoglobin level of 6.3 g/dL; she had a 1-week history of lethargy, nausea, and abdominal pain radiating to the lower back. Computed tomography (CT) of the chest and abdomen revealed air around the endograft (Video), and endoscopy demonstrated penetration of the struts of the endograft into the esophagus. In light of her diagnosis, she was scheduled for urgent and extensive two-stage open surgical correction of the AEF (Video). She was treated with vancomycin and piperacillin-tazobactam (Zosyn).

In the first stage, an extra-anatomic bypass from the ascending aorta to the infrarenal abdominal aorta was performed through a secure midline sternotomy and laparotomy. The aorta in the abdomen was found to be heavily calcified. A tunnel was fashioned by entering the lesser sac through the lesser omentum and exiting through the transverse mesocolon. The aorta was controlled at the level of the celiac axis, was difficult to close because of large, heavy sutures were required to bring the stump together into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into a secure closure.

After removal of the endograft, the distal stump, above the celiac axis, was difficult to close because of fibrosis of the tissues in an “open” position. All the visibly infected tissue was excised. Large, heavy sutures were required to bring the stump together into a secure closure. There was no visible communication with the esophagus. The neighboring scar tissues were approximated into this area. As no direct esophageal opening or fluid leak was noted, no esophageal resection was performed. Large drains were placed in this area.

The patient had a prolonged postoperative course complicated by respiratory failure necessitating reintubation, atrial
fibrillation controlled with amiodarone, and general weakness managed with physical therapy. She was kept on parenteral nutrition. Operating room culture specimens from the infected TEVAR graft grew MRSA, *Candida glabrata*, and *Lactobacillus*. She was therefore treated with a multidantibiotic regimen (vancomycin, ampicillin-sulbactam [Unasyn], and anidulafungin) for 6 weeks. She improved over time and was eventually discharged to a rehabilitation facility after 23 days.

After discharge, the patient continued to recover with a patent extra-anatomic graft as visualized by CT scan, and she resumed oral intake after normal extra-anatomic graft as visualized by CT scan, and she resumed oral intake after normal fluid overload and atelectasis, and the second was 7 months postoperatively for an episode of minor hematemesis. During the second admission, CT scan did not appear to show any extravasation of oral contrast material from the esophagus, and the gastroenterology service’s clinical supposition was that the hematemesis was due to a Mallory-Weiss tear. She did not experience further episodes of hematemesis or vomiting and was therefore discharged home. She then presented at 9 months postoperatively with left flank pain radiating to the left lower abdomen and hematemesis. A CT scan showed a large pseudoaneurysm or contained rupture in the region of the distal aortic stump. After multiple discussions, the patient elected to be made comfortable. She died shortly after. No autopsy was performed.

**DISCUSSION**

This case report and Video highlight the technical aspects of a surgical repair of an AEF after TEVAR. CT and endoscopy are the mainstays for the definitive diagnosis of AEF as the patient’s clinical presentation may be variable and nonspecific.7,8 Direct visualization and temporary management can be accomplished by endoscopy, especially in patients who are actively bleeding. However, caution must be exercised as endoscopy may itself precipitate hemorrhage.4

Because of its rarity, no consensus exists in the literature for the optimal management of AEF after TEVAR. However, there is general agreement that conservative/medical management is invariably fatal, and most specialized aortic centers advocate an aggressive staged open surgical approach as the only successful and durable repair option; in the first stage, radical debridement, stent graft and esophageal excision, and aortic reconstruction are performed, followed by esophageal reconstruction in a delayed second stage.4,5,7-10 The outlook for AEF patients is generally poor, with a 1-year mortality ranging from 30% to 64%, even at specialized centers.7-9

We believe the AEF was probably related to oversizing of the graft, with erosion of the struts. The early MRSA groin infection may have contributed through seeding of the graft. There was no history of underlying esophageal disease.

The staged approach with extra-anatomic grafting decreases the impact of explantation and reconstruction at the same time and places the new graft out of the infected field. Also, having an extra-anatomic bypass in place at the time of explantation minimizes the systemic effect of aortic cross-clamping because the visceral segment and lower body are fully perfused.

We could have used a rifampin-impregnated graft for extra infection protection. Despite the theoretical possibility of new infection of the extra-anatomic graft, there was no clinical evidence for this. We believe that the recurrent infection and subsequent pseudoaneurysm rupture occurred at the distal aortic stump, which eventually terminally ruptured into the esophagus.

There is no agreement as to what should be the ideal aortic substitute in the setting of AEF after TEVAR. The main options are an extra-anatomic aortic bypass (first described in 1969 and used with initial success in the case described), a rifampin-soaked gelatin-impregnated Dacron graft, a bovine pericardial patch fashioned into a neoaorta, and a cryopreserved aortic homograft.11-14 However, homografts may not always be readily available and may not be of sufficient length for this application.

**CONCLUSIONS**

AEF is an uncommon but well-recognized and fatal complication after TEVAR. Only an aggressive staged open surgical approach confers any chance of survival. The optimal surgical strategy must be formulated on a case-by-case basis, with the goal of eradicating the infection and reconstructing the aorta and (if indicated) esophagus.

**REFERENCES**

1. Grabenwoger M, Alfonso F, Bachtet J, Bonser R, Czerny M, Eggebrecht H, et al. Thoracic endovascular aortic repair (TEVAR) for the treatment of aortic diseases: a position statement from the European Association for Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI). Eur Heart J 2012;33:1558-63.
2. Patel HJ, Sood V, Williams DM, Dasika NL, Diener AC, Deeb GM. Late outcomes with repair of penetrating thoracic aortic ulcers: the merits of an endovascular approach. Ann Thorac Surg 2012;94:516-22; discussion: 522-3.
3. Eggebrecht H, Thompson M, Rousseau H, Czerny M, Lonn L, Mehta RH, et al. Retrograde ascending aortic dissection during or after thoracic aortic stent graft placement: insight from the European registry on endovascular aortic repair complications. Circulation 2009;120(Suppl):S276-81.
4. Chiesa R, Melissano G, Marone EM, Marrocco-Trischitta MM, Kahlberg A. Aorto-oesophageal and aortobronchial fistulae following thoracic endovascular aortic repair: a national survey. Eur J Vasc Endovasc Surg 2010;39:273-9.
5. Eggebrecht H, Mehta RH, Dechene A, Tsagakis K, Kuhl H, Huptas S, et al. Aortoesophageal fistula after thoracic aortic stent-graft placement: a rare but catastrophic complication of a novel emerging technique. JACC Cardiovasc Interv 2009;2:570-6.
6. Czerny M, Eggebrecht H, Sodeck G, Verzini F, Cao P, Maritati G, et al. Mechanisms of symptomatic spinal cord ischemia after TEVAR: insights from the European Registry of Endovascular Aortic Repair Complications (EuREC). J Endovasc Ther 2012;19:37-43.

7. Czerny M, Eggebrecht H, Sodeck G, Weigang E, Livi U, Verzini F, et al. New insights regarding the incidence, presentation and treatment options of aorto-oesophageal fistulation after thoracic endovascular aortic repair: the European Registry of Endovascular Aortic Repair Complications. Eur J Cardiothorac Surg 2014;45:452-7.

8. Luehr M, Etz CD, Nozdrzykowski M, Garbade J, Lehmkuhl L, Schmidt A, et al. Emergency open surgery for aorto-oesophageal and aorto-bronchial fistulae after thoracic endovascular aortic repair: a single-centre experience. Eur J Cardiothorac Surg 2015;47:374-82; discussion: 382-3.

9. Yamazato T, Nakamura T, Abe N, Yokawa K, Ikeno Y, Koda Y, et al. Surgical strategy for the treatment of aortoesophageal fistula. J Thorac Cardiovasc Surg 2018;155:32-40.

10. Akashi H, Kawamoto S, Saiki Y, Sakamoto T, Sawa Y, Tsukube T, et al. Therapeutic strategy for treating aortoesophageal fistulas. Gen Thorac Cardiovasc Surg 2014;62:573-80.

11. Yonago RH, Iben AB, Mark JB. Aortic bypass in the management of aortoesophageal fistula. Ann Thorac Surg 1969;7:235-7.

12. Oderich GS, Bower TC, Hofer J, Kalra M, Duncan AA, Wilson JW, et al. In situ rifampin-soaked grafts with omental coverage and antibiotic suppression are durable with low reinfection rates in patients with aortic graft enteric erosion or fistula. J Vasc Surg 2011;53:99-106, 107.e1-7; discussion: 106-7.

13. Saito A, Motomura N, Hattori O, Kinoshita O, Shimada S, Saiki Y, et al. Outcome of surgical repair of aortoesophageal fistulas with cryopreserved aortic allografts. Interact Cardiovasc Thorac Surg 2012;14:532-7.

14. Czerny M, von Allmen R, Opfermann P, Sodeck G, Dick F, Stellmes A, et al. Self-made pericardial tube graft: a new surgical concept for treatment of graft infections after thoracic and abdominal aortic procedures. Ann Thorac Surg 2011;92:1657-62.

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