



Title	One-stage radical operation of aorto-esophageal fistula -combination of VATS esophagectomy and open aortic surgery: report of a case
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Citation	Esophagus, 10(4), 280-284 <a href="https://doi.org/10.1007/s10388-013-0391-7">https://doi.org/10.1007/s10388-013-0391-7</a>
Issue Date	2013-12
Doc URL	<a href="http://hdl.handle.net/2115/57867">http://hdl.handle.net/2115/57867</a>
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## One-stage radical operation of aorto-esophageal fistula-combination of VATS and open surgery: report of a case

esophagectomy aortic

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Received: 22 April 2013 / Accepted: 31 July 2013  
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**Abstract** Aorto-esophageal fistula is a rare but fatal disease of thoracic surgery. We present a case of a 74-year-old male with aorto-esophageal fistula. The patient underwent successful one-stage surgical treatment by video-assisted esophagectomy with esophageal reconstruction by gastric conduit and open aortic graft replacement subsequent to a temporary thoracic endovascular aortic repair.

**Keywords** Aorto-esophageal fistula · VATS esophagectomy · One-stage operation

### Introduction

Aorto-esophageal fistula (AEF) is a rare but fatal disease of thoracic surgery. Although thoracic endovascular aortic repair (TEVAR) is useful for nonfistulous aortic aneurysm, the application of TEVAR to AEF is considered a bridging therapy prior to a radical operation comprising aortic replacement and esophageal removal and reconstruction [1]. We present a case involving one-stage radical operation of AEF performed by video-assisted thoracoscopic surgery (VATS) for esophagectomy with esophageal reconstruction by gastric conduit as well as open aortic

graft replacement subsequent to a temporary TEVAR. This is the first report describing the advantages of one-stage radical operation of AEF after TEVAR. Inclusion of TEVAR converts this highest-risk emergent operation into an elective operation. Moreover, the combination of the increased safety resulting from the inclusion of TEVAR and the reduced invasiveness of VATS makes this simultaneous operation feasible.

### Case

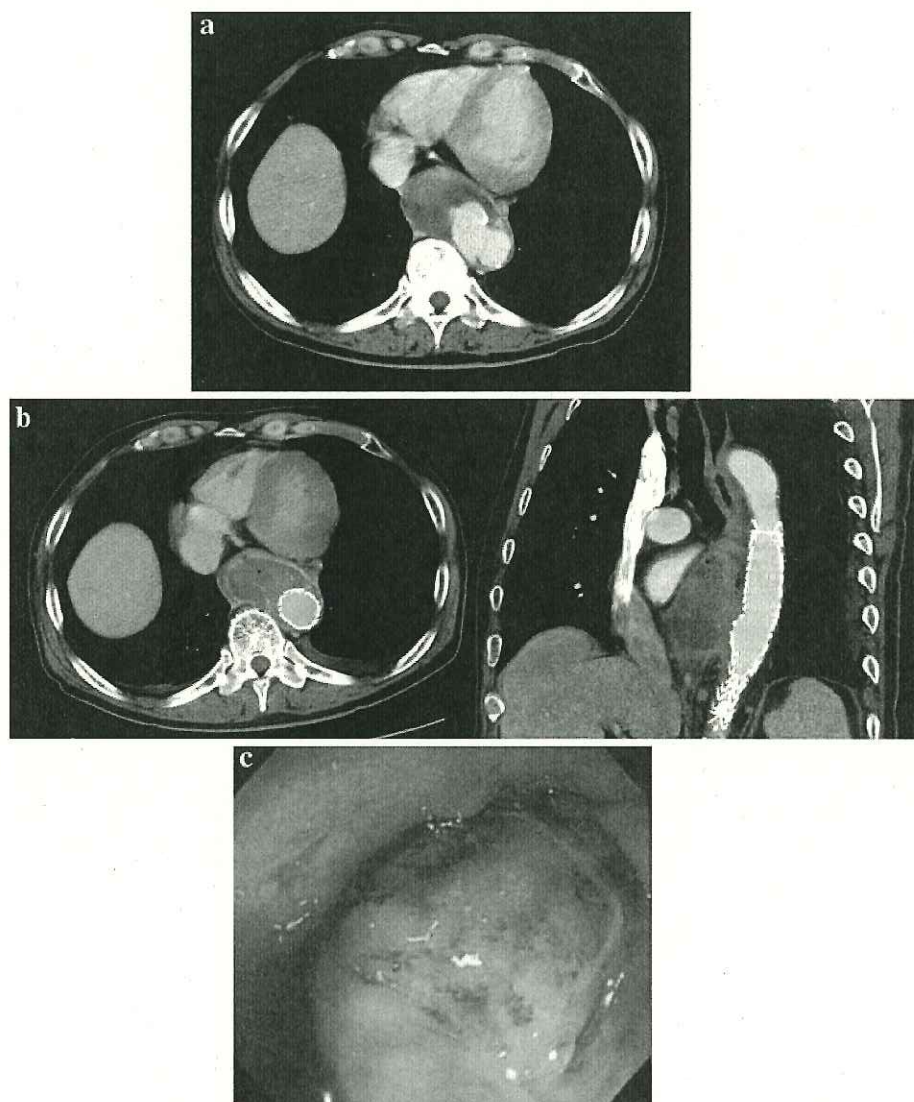
A 74-year-old male who had been treated for methicillin-resistant *Staphylococcus aureus* pyelonephritis after a radical cystectomy for bladder cancer had symptoms of epigastralgia and hematemesis. He was diagnosed with an impending rupture of a thoracic aortic aneurysm (TAA) of the descending aorta, and TEVAR was applied in an affiliated hospital. The day after the TEVAR was performed, upper gastrointestinal fiberoptic revealed AEF (Fig. 1). He was transferred to our hospital for further curative surgical intervention. Post transfer, the patient's general condition was stable, his body temperature was also normal, there was no evidence of a progressive life-threatening infection such as mediastinitis, pyothorax, or synthetic graft infection, and the laboratory data showed elevated CRP (19.46 mg/dl) while WBC and procalcitonin levels were within their normal limits. The elevation of the CRP level was, however, persistent; this was presumably due to MRSA pyelonephritis, which caused the infections thoracic aneurysm.

Since the physical condition of the patient was fair, a one-stage radical operation consisting of VATS esophagectomy with esophageal reconstruction by gastric conduit and open operation of TAA by prosthetic graft was

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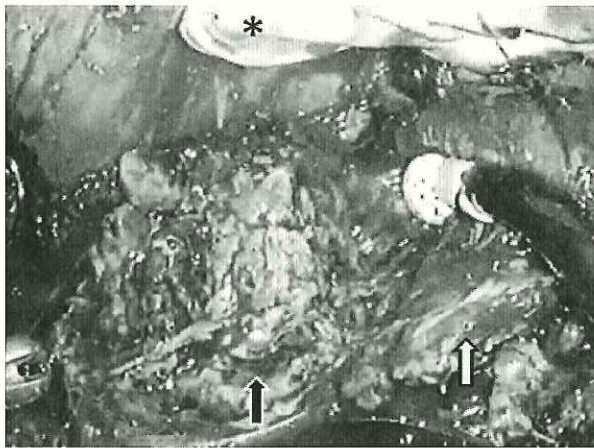
**Fig. 1** **a** Impending rupture of the thoracic aortic aneurysm was diagnosed by computed tomography. **b** Computed tomography after thoracic endovascular aortic repair showed entrapment of air within the hematoma of the aneurysm. **c** Endoscopic examination confirmed the presence of an aorto-esophageal fistula. Extrinsic compression of the wall with erosion in the lower thoracic esophagus was confirmed. Ulcerative change and disruption of the mucosa were confirmed at the top of the protruded site



63 performed on the day of the transfer. It took place 1 week  
64 after the onset of TAA and 2 days after the TEVAR  
65 treatment.

66 The operation was performed as follows. First, VATS  
67 esophagectomy was performed by a gastroenterological  
68 surgery team using the hand-assisted thoracoscopic surgery  
69 (HATS) procedure [2]. Placing the patient in the left lateral  
70 decubitus position, six small incisions for thoracoscopic  
71 ports were made to the right thoracic wall, with the assistant  
72 inserting his left hand into the thoracic cavity from the  
73 middle upper abdominal incision thorough the anterior  
74 phrenodiaphragmatic route. Esophagectomy was performed  
75 with the aid of the assistant's left hand and fingers to retract  
76 the lung and obtain a wide working space and for anatomical  
77 confirmation around the AEF. Although the upper esophagus  
78 was easily separated from the trachea, inflammation of the

79 posterior mediastinum was observed around the middle to  
80 lower esophagus and the AEF was confirmed with the  
81 hematoma of the posterior mediastinum (Fig. 2). The entire  
82 thoracic esophagus was detached from the mediastinum  
83 except for the 23 × 18 mm defect of the perforated site.  
84 After lavage of the hematoma, both ends of the divided  
85 esophagus were sutured and bridged by a Teflon tape to  
86 prepare for a gastric pull-up, and the wounds were closed.  
87 Then aortic reconstruction was performed by the cardio-  
88 vascular team. With the patient in the hemi-right decubitus  
89 position, a seventh intercostal thoracic incision was made.  
90 After commencing the cardiopulmonary bypass through the  
91 right femoral artery and vein, the descending thoracic aorta  
92 was clamped and incised. The previously inserted stent graft  
93 was removed without any difficulty and the orifice of the  
94 AEF was revealed. Because the orifice was blocked with



**Fig. 2** Video-assisted esophagectomy. Hand-assisted thoracoscopic surgery was performed; the entire thoracic esophagus was detached from the mediastinum except for the 23 × 18 mm defect at the perforated site. The asterisk indicates the assistant's left hand retracting the pericardium. Hematoma was confirmed (black arrow) beneath the lower esophagus (white arrow)

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95 hematoma without any apparent signs of infection (such as  
 96 abscess formation), a prosthetic graft replacement was ini-  
 97 tially performed. Then, to prevent contamination, removal of  
 98 hematoma and resection of the aortic wall involved by the  
 99 aneurysm as well as debridement and irrigation of the  
 100 residual aortic wall were done. The wound was temporarily  
 101 closed and the operation was again transferred to the gas-  
 102 troenterological team. Since the vital signs of the patient  
 103 were stable, we decided to continue with the esophageal  
 104 reconstruction. Open laparotomy was performed by pro-  
 105 longing the incisional site of the HATS scar in the upper  
 106 abdomen using the spine position. To achieve both esopha-  
 107 geal reconstruction and coverage of the aorta graft, a gastric  
 108 conduit was generated with full preservation of the greater  
 109 omentum (Fig. 3). The gastric conduit was pulled up to the  
 110 cervical incision through the posterior mediastinal route  
 111 and anastomosed to the remaining cervical esophagus by  
 112 functional end-to-end anastomosis with linear staplers. Tube  
 113 jejunostomy for enteral nutrition was performed. Finally, the  
 114 cardiovascular team reopened the intercostal incision. After  
 115 full lavage of the perforated site, the greater omentum, which  
 116 had already been pulled up with the gastric conduit, was  
 117 drawn from the right thoracic cavity to the left and placed  
 118 between the aortic wall and the prosthesis to prevent a sec-  
 119 ondary graft infection (Fig. 3).

120 The patient recovered well from the operation. He was  
 121 extubated on postoperative day (POD) 1 and discharged  
 122 from the intensive care unit on POD2. Oral intake was  
 123 started from POD7, and then he was discharged on POD43  
 124 without any postoperative complication except for pro-  
 125 longed chest tube insertion for pleural fluid.

**Discussion**

Radical operation of AEF is usually done by multi-stage 127  
 surgery, since simultaneous right open thoracotomy for 128  
 esophageal removal and reconstruction and left thoracot- 129  
 omy for aortic replacement is excessively invasive for 130  
 patients. In this case, to achieve a one-stage radical oper- 131  
 ation, we employed VATS esophagectomy by the HATS 132  
 procedure in order to minimize the surgical invasiveness 133  
 and maximize the safety of the procedure [2]. 134

The merit of one-stage radical operation is that esopha- 135  
 geal reconstruction with a gastric conduit and coverage of 136  
 the synthetic aortic graft by a sufficient volume of the 137  
 greater omentum can be performed simultaneously. In the 138  
 case of multi-stage surgery, the harvest of the greater 139  
 omentum for plombage means that we must forego the 140  
 choice of most secure and reliable esophageal reconstruc- 141  
 tion procedure (via gastric conduit) in the final stage of the 142  
 operation. 143

Preoperative TEVAR treatment was also chosen for the 144  
 one-stage operation to minimize the risk of bleeding during 145  
 VATS esophagectomy. Although TEVAR is useful for a 146  
 nonfistulous aortic aneurysm, the application of TEVAR to 147  
 AEF is considered a bridging therapy prior to a radical 148  
 operation comprising aortic replacement and esophageal 149  
 removal and reconstruction [1]. Since the existence of 150  
 aortoenteric fistula will result in an infection of the syn- 151  
 thetic graft, a curative operation consisting of the removal 152  
 of the enteric fistula and graft repair of the aortic aneurysm 153  
 with the removal of the TEVAR should be done at the 154  
 earliest opportunity [1]. Jonker et al. [1] reviewed 71 cases 155  
 of TEVAR for AEF and summarized that AEF patients 156  
 who had received esophageal surgery in the first 30 days 157  
 after TEVAR showed a lower fistula-related mortality rate. 158  
 TEVAR as a bridge therapy will give a days-to-weeks 159  
 period to prepare for the radical operation, allowing the 160  
 patient's physical condition to be checked via routine 161  
 medical examinations, malnutrition to be remedied, and 162  
 preoperative respiratory rehabilitation. 163

Our experience of VATS esophagectomy encouraged us 164  
 to perform this one-stage operation: we have performed 165  
 over a hundred VATS esophagectomies for esophageal 166  
 cancer and have found that the incidence of anastomotic 167  
 leakage of gastric conduit reconstruction is about 5 % 168  
 (unpublished data). We had also recently undertaken a one- 169  
 stage operation of an AEF caused by previous aortic graft 170  
 placement by performing VATS esophagectomy and 171  
 simultaneous reconstruction by gastric conduit [3]. 172

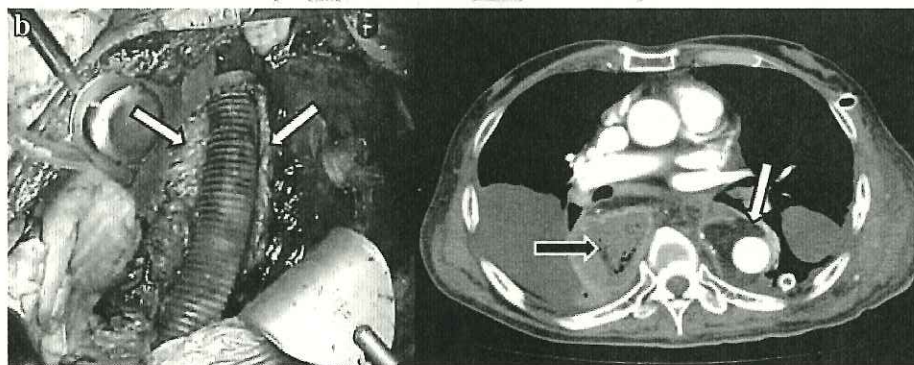
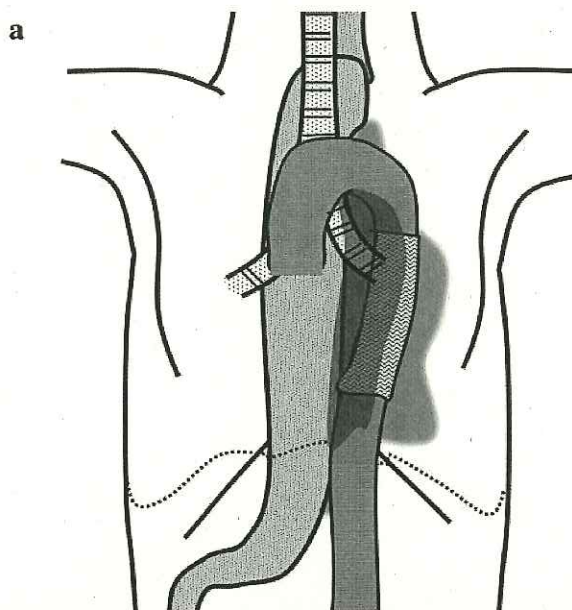
The indication of a one-stage radical operation of AEF 173  
 is limited by the physical status of the patient, and the 174  
 strategy of the operation should be carefully designed. In 175  
 this particular case, the absence of an obvious infection of 176  
 the synthetic stent graft and the hematoma meant that this 177

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**Fig. 3** Aortic replacement and digestive reconstruction.

**a** Schematic drawing of the digestive reconstruction and the omental flap plompage. To achieve both esophageal reconstruction and coverage of the aorta graft, the gastric conduit was pulled up to the cervical incision through the posterior mediastinal route. The greater omentum with the gastric conduit was drawn from the right thoracic cavity to the left and placed between the aortic wall and the prosthesis to prevent a secondary graft infection. The greater omentum is shown as a *gray shadow*.

**b** Operative and postoperative findings after aorta replacement and omental flap plompage. Reconstruction of the aorta with the removal of the intra-aortic covered stent and replacement with a 22 mm prosthetic graft. The greater omentum (*white arrows*), which was pulled up with the gastric conduit (*black arrow*), was used for omental flap plompage to cover the mediastinal side of the aortic graft to prevent a secondary graft infection



**Table 1** Therapeutic strategies for aorto-esophageal fistula

	Purpose	Operative procedures	
		One-stage	Multi-stage
Diagnosis of AEF	Prevention of Hemorrhage	TEVAR	
First-stage operation	Fistula removal	Esophagectomy (VATS)	Esophagectomy (VATS) w/o reconstruction; cervical esophagostomy and feeding gastrostomy
Second-stage operation (with 1st- or 2nd-stage op.)	Aorta replacement	Graft repair (homo or synthetic), with stent graft removal	
	Infection control	Omental flap plompage	
Final-stage operation	Digestive reconstruction	Gastric conduit	Pedicled jejunum/ileocolic reconstruction (with microvascular anastomosis)

VATS video-assisted thoracoscopic surgery, TEVAR thoracic endovascular aortic repair

Centering

178 radical operation could be tolerated by the patient. We also  
 179 planned for an alternative strategy based on multi-step  
 180 surgery in the event that we experienced difficulty in  
 181 continuing the one-stage operation due to an accident

during the operation or problems due to the patient's  
 physical condition during the anesthesia and the operation.  
 Our back-up plan was as follows: removal of the esophagus  
 by VATS, cervical esophagostomy, and a feeding

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186 gastrostomy as the minimal but essential aim of the first  
 187 stage of surgery; when the operation could be continued,  
 188 aortic graft replacement with coverage of the graft by the  
 189 greater omentum would have been performed simulta-  
 190 neously, and a pedicled jejunum or ileocolic reconstruction  
 191 of the esophagus would have represented the final part of  
 192 the multi-stage operation (Table 1).

193 In conclusion, if the patient can physically tolerate both  
 194 VATS and open aortic repair, a one-stage operation com-  
 195 prising VATS esophagectomy with esophageal recon-  
 196 struction by gastric conduit and open aortic graft  
 197 replacement subsequent to TEVAR is the ideal and  
 198 achievable option for a radical operation of AEF.

199 **Ethical Statement** The work reported in this article did not involve  
 200 any studies of human or animal subjects performed by any of the  
 201 authors.

**Conflict of interest** There are no financial or other relations that  
 could lead to a conflict of interest for this work.

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