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Author(s)	Shichinohe, Toshiaki; Wakasa, Satoru; Kubota, Suguru et al.
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CASE REPORT

One-stage radical operation of aortoesophageal fistula-combination of VATS and open surgery: report of a case

Toshiaki Shichinohe · Satoru Wakasa · Suguru Kubota · Kentaro Kato · Yuma Ebihara · Yo Kurashima · Takahiro Tsuchikawa · Eiichi Tanaka · Yoshiro Matsui · Satoshi Hirano

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Abstract Aortoesophageal fistula is a rare but fatal disease of thoracic surgery. We present a case of a 74-year-old male with aortoesophageal 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 Aortoesophageal fistula · VATS esophagectomy · One-stage operation

Introduction

Aortoesophageal 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 fiberscope 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

T. Shichinohe (✉) · K. Kato · Y. Ebihara · Y. Kurashima · T. Tsuchikawa · E. Tanaka · S. Hirano
Department of Gastroenterological Surgery II, Hokkaido University Graduate School of Medicine, West-7, North-15, Kitaku, Sapporo, Hokkaido 060-8638, Japan
e-mail: shichino@med.hokudai.ac.jp

S. Wakasa · S. Kubota · Y. Matsui
Department of Cardiovascular and Thoracic Surgery, Hokkaido University Graduate School of Medicine, Sapporo, Japan

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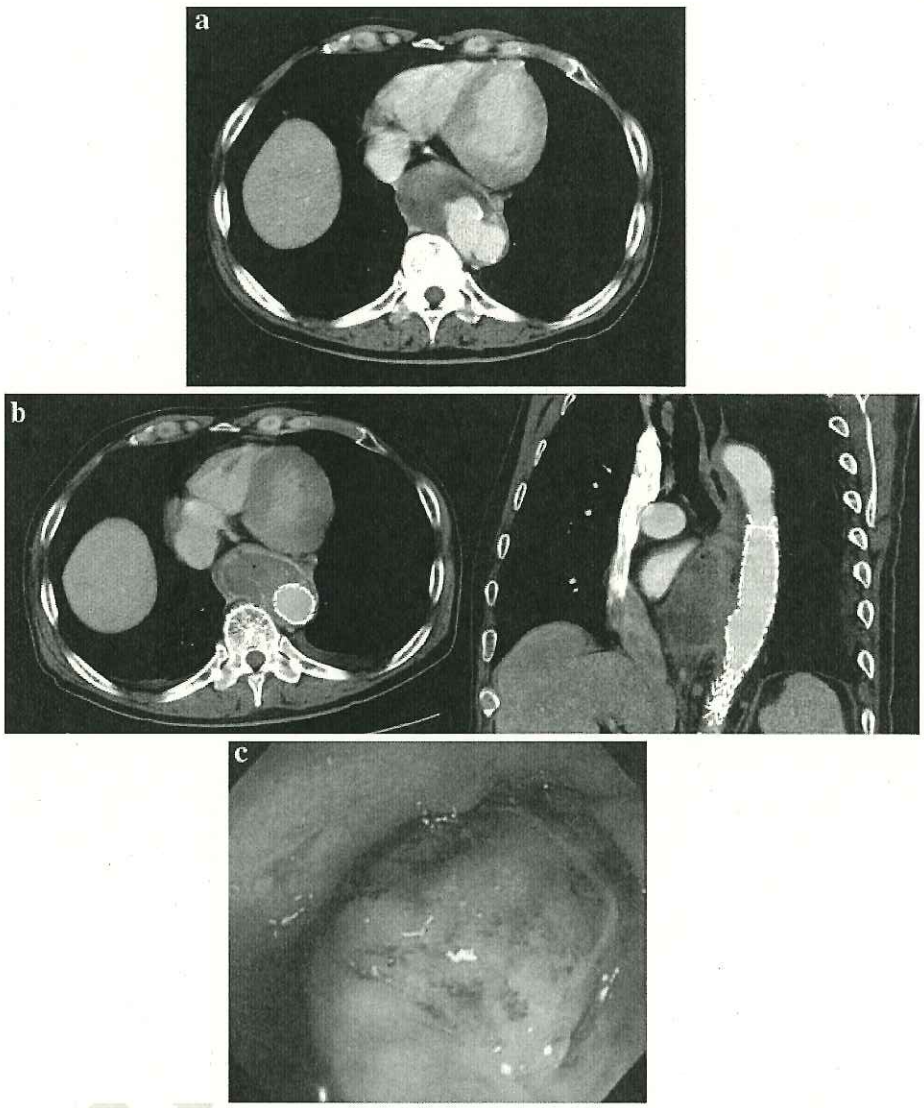

Fig. 1 **a** Impending rupture of the thoracic aortic aneurysm was diagnosed by computed tomography. **b** Computed tomography after thoracic endovascular aortic repair showed entrapment of air within the hematoma of the aneurysm. **c** Endoscopic examination confirmed the presence of an aortoesophageal 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

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

The operation was performed as follows. First, VATS esophagectomy was performed by a gastroenterological surgery team using the hand-assisted thoracoscopic surgery (HATS) procedure [2]. Placing the patient in the left lateral decubitus position, six small incisions for thoracoscopic ports were made to the right thoracic wall, with the assistant inserting his left hand into the thoracic cavity from the middle upper abdominal incision thorough the anterior phrenomediastinal route. Esophagectomy was performed with the aid of the assistant's left hand and fingers to retract the lung and obtain a wide working space and for anatomical confirmation around the AEF. Although the upper esophagus was easily separated from the trachea, inflammation of the posterior mediastinum was observed around the middle to lower esophagus and the AEF was confirmed with the hematoma of the posterior mediastinum (Fig. 2). The entire thoracic esophagus was detached from the mediastinum except for the 23 × 18 mm defect of the perforated site. After lavage of the hematoma, both ends of the divided esophagus were sutured and bridged by a Teflon tape to prepare for a gastric pull-up, and the wounds were closed. Then aortic reconstruction was performed by the cardiovascular team. With the patient in the hemi-right decubitus AQ4 position, a seventh intercostal thoracic incision was made. After commencing the cardiopulmonary bypass through the right femoral artery and vein, the descending thoracic aorta was clamped and incised. The previously inserted stent graft was removed without any difficulty and the orifice of the AEF was revealed. Because the orifice was blocked with

half lateral

the right half lateral decubitus position

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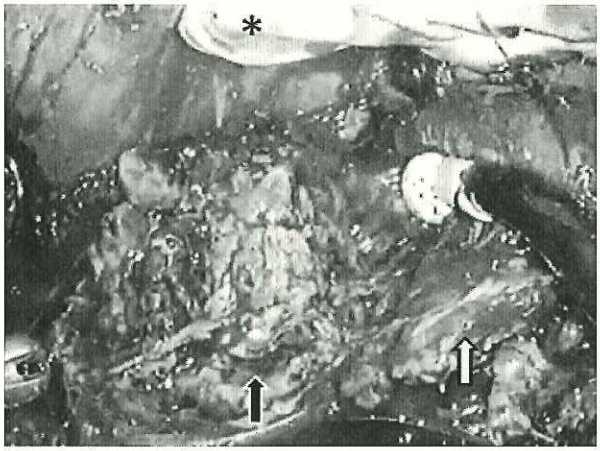

Fig. 2 Video-assisted esophagectomy. Hand-assisted thoracoscopic surgery was performed; the entire thoracic esophagus was detached from the mediastinum except for the 23 × 18 mm defect at the perforated site. The *asterisk* indicates the assistant's left hand retracting the pericardium. Hematoma was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

hematoma without any apparent signs of infection (such as abscess formation), a prosthetic graft replacement was initially performed. Then, to prevent contamination, removal of hematoma and resection of the aortic wall involved by the aneurysm as well as debridement and irrigation of the residual aortic wall were done. The wound was temporarily closed and the operation was again transferred to the gastroenterological team. Since the vital signs of the patient were stable, we decided to continue with the esophageal reconstruction. Open laparotomy was performed by prolonging the incisional site of the HATS scar in the upper abdomen using the spine position. To achieve both esophageal reconstruction and coverage of the aorta graft, a gastric conduit was generated with full preservation of the greater omentum (Fig. 3). The gastric conduit was pulled up to the cervical incision thorough the posterior mediastinal route and anastomosed to the remaining cervical esophagus by functional end-to-end anastomosis with linear staplers. Tube jejunostomy for enteral nutrition was performed. Finally, the cardiovascular team reopened the intercostal incision. After full lavage of the perforated site, the greater omentum, which had already been pulled up 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 (Fig. 3).

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

Discussion

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

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

Preoperative TEVAR treatment was also chosen for the one-stage operation to minimize the risk of bleeding during VATS esophagectomy. Although TEVAR is useful for a 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]. Since the existence of aortoenteric fistula will result in an infection of the synthetic graft, a curative operation consisting of the removal of the enteric fistula and graft repair of the aortic aneurysm with the removal of the TEVAR should be done at the earliest opportunity [1]. Jonker et al. [1] reviewed 71 cases of TEVAR for AEF and summarized that AEF patients who had received esophageal surgery in the first 30 days after TEVAR showed a lower fistula-related mortality rate. TEVAR as a bridge therapy will give a days-to-weeks period to prepare for the radical operation, allowing the patient's physical condition to be checked via routine medical examinations, malnutrition to be remedied, and preoperative respiratory rehabilitation.

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

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

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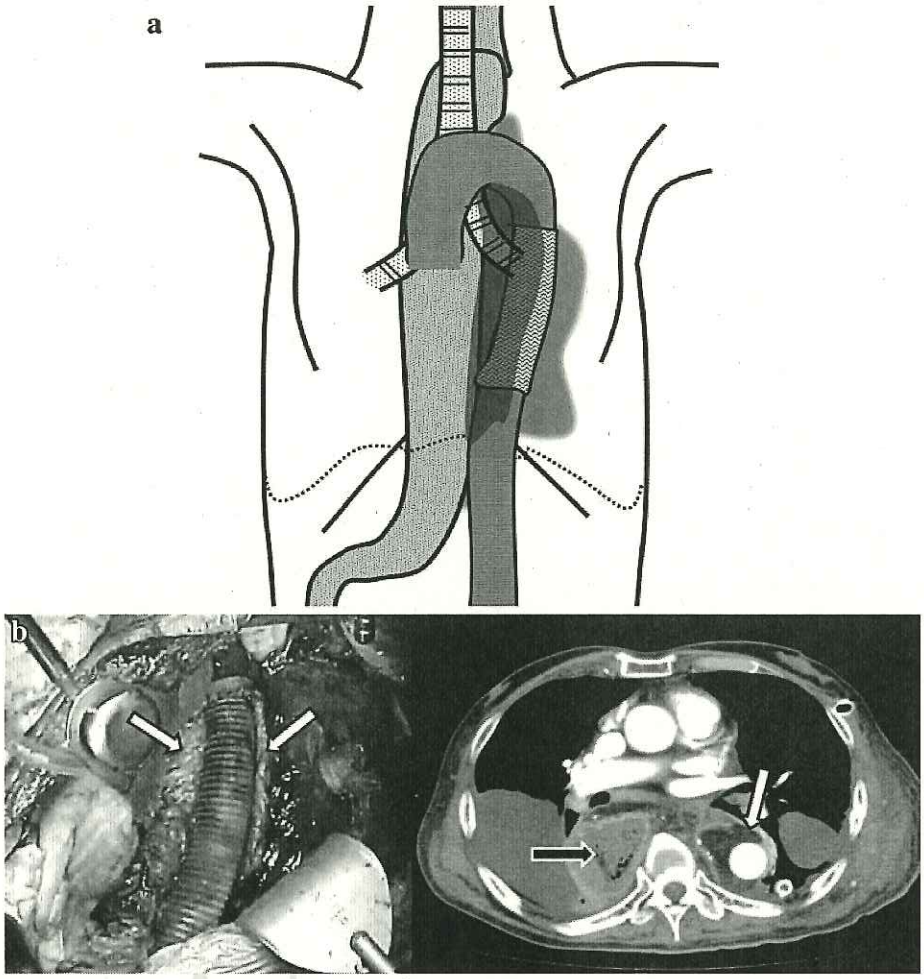

Fig. 3 Aortic replacement and digestive reconstruction. **a** Schematic drawing of the digestive reconstruction and the omental flap plombage. To achieve both esophageal reconstruction and coverage of the aorta graft, the gastric conduit was pulled up to the cervical incision thorough the posterior mediastinal 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 plombage. 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 plombage to cover the mediastinal side of the aortic graft to prevent a secondary graft infection

Table 1 Therapeutic strategies for aortoesophageal 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	Aorta replacement	Graft repair (homo or synthetic), with stent graft removal	
(with 1st- or 2nd-stage op.)	Infection control	Omental flap plombage	
Final-stage operation	Digestive reconstruction	Gastric conduit	Pedicled jejunum/ileocolic reconstruction (with microvascular anastomosis)

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

radical operation could be tolerated by the patient. We also planned for an alternative strategy based on multi-step surgery in the event that we experienced difficulty in 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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gastrostomy as the minimal but essential aim of the first stage of surgery; when the operation could be continued, aortic graft replacement with coverage of the graft by the greater omentum would have been performed simultaneously, and a pedicled jejunum or ileocolic reconstruction of the esophagus would have represented the final part of the multi-stage operation (Table 1).

In conclusion, if the patient can physically tolerate both VATS and open aortic repair, a one-stage operation comprising VATS esophagectomy with esophageal reconstruction by gastric conduit and open aortic graft replacement subsequent to TEVAR is the ideal and achievable option for a radical operation of AEF.

Ethical Statement The work reported in this article did not involve any studies of human or animal subjects performed by any of the 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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