Salvage Robotic-Assisted Thoracoscopic Esophagectomy after Definitive Chemoradiotherapy for Clinical T4b Esophageal Cancer: A Case Report

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Case report

Keywords: robotic-assisted thoracoscopic esophagectomy, definitive chemoradiotherapy, salvage surgery

Posted Date: March 15th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-291574/v1

Version of Record: A version of this preprint was published at Annals of Thoracic and Cardiovascular Surgery on January 1st, 2021. See the published version at https://doi.org/10.5761/atcs.cr.21-00175.

Abstract

Background

Although twenty years have passed since the start of robot-assisted thoracoscopic esophagectomy, salvage esophagectomy by robotic-assisted surgery has not yet been introduced by almost surgeons. Theoretically, robot-assisted thoracoscopic esophagectomy (RATE) increases operative precision and maneuverability within the narrow space of the mediastinum. However, surgeons have doubted that RATE is indicated for patients with tumor invasion of adjacent vital organs clinically (cT4b) or patients with scar tissue from definitive chemoradiotherapy. Herein, we report our case of salvage RATE for cT4b thoracic esophageal cancer which invaded to the left main bronchus before definitive chemoradiotherapy.

Case presentation

A man in his 60's with middle thoracic esophageal cancer [cT4b (left main bronchus) N1 M0 cStage IIIC] received definitive chemoradiotherapy (fluorouracil and cisplatin, total radiation dose of 60 Gy). After the chemoradiotherapy, upper gastrointestinal endoscopy revealed a residual primary tumor, and we performed robotic-assisted thoracoscopic subtotal esophagectomy and gastric tube reconstruction via a retrosternal route with three-field lymphadenectomy. Although it was difficult to dissect the tumor from adjacent organs, especially in the left main bronchus and pericardium, due to the scarring after definitive chemoradiotherapy, R0 surgery was achieved. With RATE, the high-resolution three-dimensional images, stable surgical field and stable motion are considerable advantages for salvage esophagectomy for cT4b tumors. At present (30 months after surgery), the patient's performance status is 0 and he is alive without a recurrence.

Conclusions

Robot-assisted thoracoscopic esophagectomy provided considerable advantages for salvage esophagectomy after definitive chemoradiotherapy for a cT4b tumor.

Background

Twenty years have passed since the first transthoracic robot-assisted thoracoscopic esophagectomy (RATE) by Giulianotti or Kernstine (1-2). After the first report of RATE, RATE expanded rapidly in the world. In Japan, RATE is now performed at many institutions especially after it began being covered by the national health insurance in 2018 (3). Theoretically, RATE increases operative precision and maneuverability within the narrow space of the mediastinum. However, surgeons have doubted that RATE is indicated for patients with tumor invasion of adjacent vital organs clinically (cT4b) or patients with scar tissue from definitive chemoradiotherapy (dCRT). On the other hand, salvage RATE after dCRT is well-balanced with respect to surgical stress to patients and the definitiveness of surgical treatment due to operative precision and maneuverability. Herein, we report our experience with a case of salvage RATE for cT4b thoracic esophageal cancer which invaded to the left main bronchus before dCRT.

Case Presentation

A man in his 60's visited to our hospital because he was experiencing dysphagia. An upper gastrointestinal endoscopy showed a circumferential type III tumor, which was 29-38 cm from the incisors. A biopsy revealed poorly differentiated squamous cell carcinoma. Contrast-enhanced computed tomography (CE-CT) revealed wall thickness in the middle thoracic esophagus with a suspicious finding suggesting invasion of the bilateral main bronchus and pericardium (Figure 1). In addition, a middle thoracic paraesophageal lymph node was swollen (cN1). Bronchoscopy showed redness and immobility of the membranous portion of the left main bronchus during coughing, which was diagnosed invasion of the left main bronchus by the main tumor. Therefore, this patient was diagnosed with middle thoracic esophageal cancer, cT4b (left main bronchus) N1 M0, cStage IIIC according to the International Union Against Cancer tumor-node-metastasis (TNM) Classification of Malignant Tumors (eight edition) and underwent dCRT with fluorouracil (800 mg/m^2/day) on days 1-5, combined with cisplatin (80 mg/m^2/day) on day 1. This protocol was repeated twice with 3-week intervals in between, and the total radiation dose was 60 Gy. After the definitive CRT, CE-CT revealed significant shrinkage of the primary focus and lymph nodes, and upper gastrointestinal endoscopy revealed an ulcer distorted by the primary focus, which grossly confirmed an incomplete response and the presence of a residual tumor (Figure 1). The maximum standardized uptake value of the primary focus in systematic [^{18}F] fluorodeoxyglucose-positron emission tomography/computed tomography had decreased from 15.0 to 3.5. Bronchoscopy revealed mobility of the left main bronchus during coughing, which had not previously been seen. Considering these findings and the patient's desire, salvage surgery was performed 2 months after the final irradiation to achieve a complete cure (4-5).

We performed a salvage RATE with three-field lymphadenectomy and gastric tube reconstruction via a retrosternal route. The patient was placed in the left lateral position under a combination of inhaled and intravenous anesthesia, and a double-lumen endotracheal tube was used for single-lung ventilation during the thoracic part of the surgery (6). The right arm was raised 60 degrees cranially to expose the right axillar fossa, then tilted 20 degrees cranially and 15 degrees ventrally. The assistant surgeons stood on the left side of the patient. A small incision (20 mm in length) was made in the 4th intercostal space (ICS), anterior to the midaxillary line, and a mini-thoracotomy was performed under direct vision. This was prepared for emergency chest opening in the event of a surgical emergency during the operation. The da Vinci trocars (8 mm) were inserted into the 2nd ICS, on the anterior axillary line (AL); the 5th ICS, on the middle AL; the 7th ICS, on the middle AL; and the 10th ICS on the posterior AL. We mainly used a forward-oblique viewing endoscope during the thoracic portion of the surgery. In the middle-lower mediastinum, the right main bronchus, right inferior pulmonary vein, and pericardium were isolated from the scarred mediastinal tissue, and the tumor and scarred mediastinal tissue were dissected from the preserved tissues (Figure 2)(Video 1). The lower and upper thoracic esophagus were taped, and the esophagus was divided above diaphragm and at the level of the aortic arch. While tugging the bilateral edges of the esophagus, the scarred tumor, which adhered to a lymph node, was dissected from the left inferior pulmonary vein, left main bronchus, and pericardium. A very severe scar on the dorsal surface of the left

main bronchus was separated by careful dissection with the RATE system (Figure 2). The left vagal nerve, which also had scar tissue, was resected above the main trunk, and a mediastinal lymphadenectomy was performed. The pericardium (fibrous and serous pericardium) was opened about 5 cm caudal to the level of the inferior pulmonary vein, to prevent tamponade caused by pooling of pericardial effusion after the salvage esophagectomy. In the abdominal surgery, upper abdominal lymphadenectomy and construction of a gastric tube were performed using hand-assisted laparoscopic surgery. At the same time, cervical lymph node dissection was performed. The gastric tube was lifted via a retrosternal route, and hand sewn anastomoses (two-layer, end-to-end) were constructed. A gastrostomy for a tube feeding was made on the wall of the gastric antrum. The total operation time was 11 hours and 16 minutes, and total hemorrhage volume was 308 ml.

After the salvage surgery, the patient's condition was complicated by transient left recurrent nerve palsy (Clavien-Dindo classification (CD) I) and pneumonia (CD IIIa), and he was administered an antibiotic (7). On POD 29, severe pericardial effusion developed, which was most likely due to the radiation. Pericardial drainage was performed under ultrasound cardiography, and 400 ml of serous pericardial effusion was drained. We controlled pericardial and pleural effusion with 20 mg of prednisolone, and the patient was discharged from our hospital on POD 51. Pathological findings revealed none of tumor remained; there was pathological complete remission for both the tumor and lymph nodes. At present (30 months after surgery), the patient's performance status is 0 and he is alive without a recurrence.

Discussion And Conclusions

RATE has been reported to i) increase maneuverability with high-resolution three-dimensional images and a highly magnified view; ii) enable the operator to use forceps to access narrow spaces unreachable by hand with a good range of motion thanks to the seven robotic arms joints; iii) eliminate tremors in the surgeon's hands and provide stable motions (1, 2, 3, 6, 8). Theoretically, these features help surgeons execute more accurate and precise maneuvers. However, RATE has disadvantages. For example, there is an absence of the tactile sensation one has with thoracoscopic or open surgery. This disadvantage underlies the difficulty of using RATE for salvage esophagectomy in patients with invasion of adjacent visceral organs (cT4b) or patients who have severe scarring after dCRT. Previous studies have reported R0 resection, absence of complications, and pStages 0-2 as prognostic factors in salvage esophagectomy. However, whether or not R0 resection is possible, it is difficult to determine invasion of adjacent organs using current imaging, especially after dCRT (9-11). In cases with suspected tracheal and aortic invasion, intraoperative findings may show the presence of significant fibrosis between the tumor and the adjacent vital organs, even when no tumor cells are present on the dissected surface. Consequently, salvage esophagectomy after dCRT is considered to be technically difficult and to have a higher rate of postoperative complications. To reduce postoperative complications, surgeons try to preserve the bilateral bronchial arteries as much as possible to prevent postoperative tracheobronchial ischemia. In the present case, however, severe fibrosis around the tumor did not allow preservation of the right bronchial artery, but the left bronchial artery was preserved. In addition, to prevent tamponade due to pooling of pericardial effusion after salvage esophagectomy, we opened the pericardium during the

operation, though this was not effective. The reason was that the portion of the opened pericardium was not suitable. It appeared to be opened near the apex during the abdominal operation. Note that lymph node dissection was performed as it is performed for non-salvage esophagectomy. This is because salvage resection is a one-chance treatment and necessary for R0 resection.

There are few reports of salvage RATE after definitive CRT for thoracic esophageal cancer. With RATE, the high-resolution three-dimensional images, stable surgical field and stable motion are considerable advantages for salvage esophagectomy for cT4b tumors. One report suggests that operators can learn to compensate for the absence of tactile sensation through the use of visual sensation and repetitive practice to improve robotic-assisted surgery skills (12). Another report describes tactile feedback techniques using simulation (13).

We experienced a case of cT4b thoracic esophageal cancer in which the patient was treated with salvage RATE after dCRT. RATE provided a stable surgical field and stable motion, which was a considerable advantage for salvage esophagectomy after definitive chemoradiotherapy for a cT4b tumor. We anticipate that salvage RATE for esophageal cancer will become a standard surgery in the near future.

Abbreviations

RATE: robot-assisted thoracoscopic esophagectomy

dCRT: definitive chemoradiotherapy

cT4b: clinical T4b

CE-CT : contrast-enhanced computed tomography

POD: postoperative day

ICS : intercostal space

AL: axillary line

CD: Clavien-Dindo classification

Declarations

Ethics approval and consent to participate Approved by the Ethics Committee of Akita University Graduate School of Medicine (No. 1222). The participant provided informed consent and signed a human subject institutional review board consent form.

Consent for publication: Consent to publish was obtained from this patient.

Availability of data and materials: Data used in this study are available on reasonable request from the corresponding author.

Competing interests: No conflict of interest regarding this study.

Funding: No financial relations that could lead to a conflict of interest regarding this study.

Authors' contributions: All authors contribute this case report.

Acknowledgements: None

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Figures

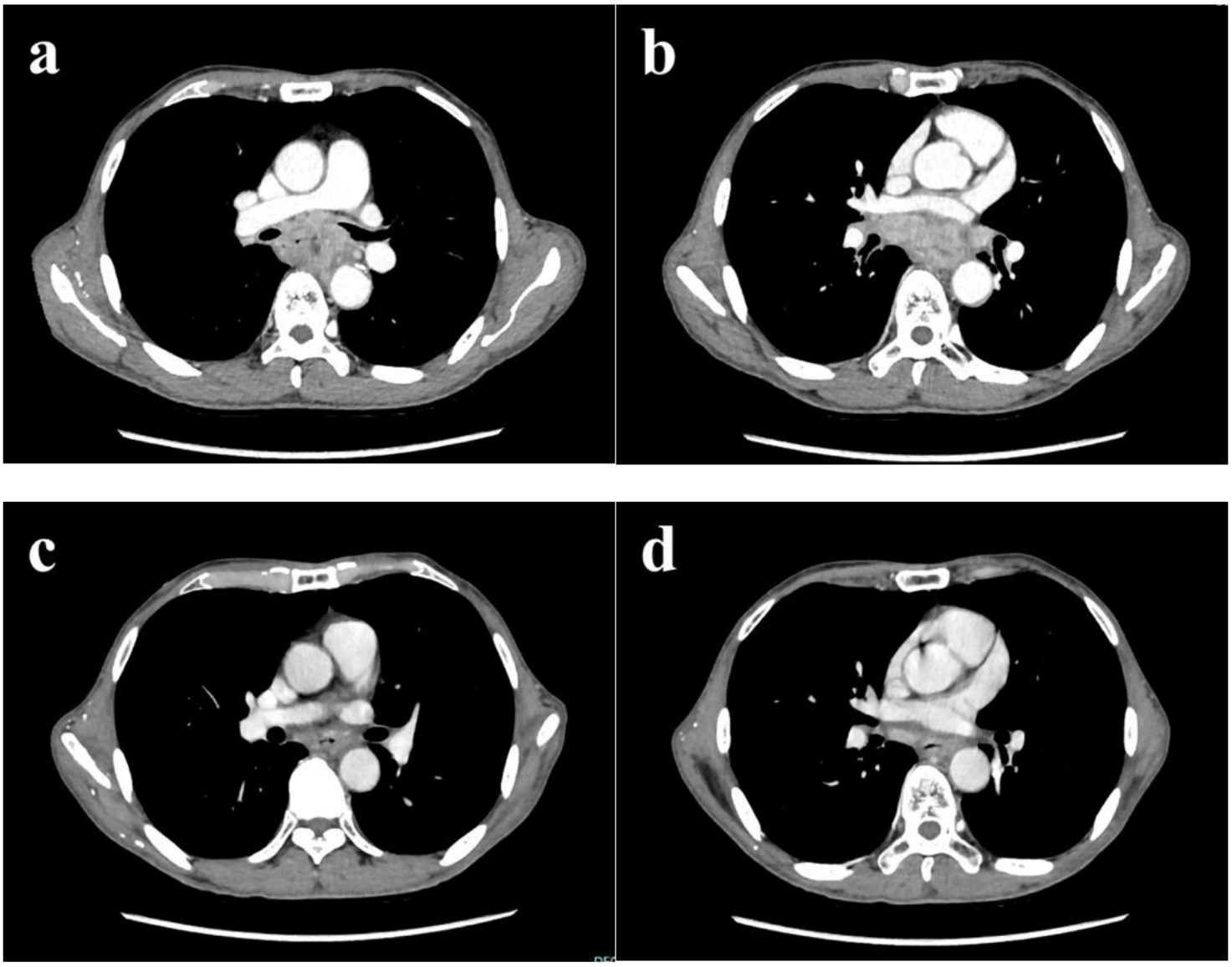

Figure 1

Contrast-enhanced computed tomography showing wall thickness in the middle thoracic esophagus with a suspicious finding suggesting invasion of the bilateral main bronchus and pericardium (a,b). After definitive chemoradiotherapy, these findings were reduced (c, d).

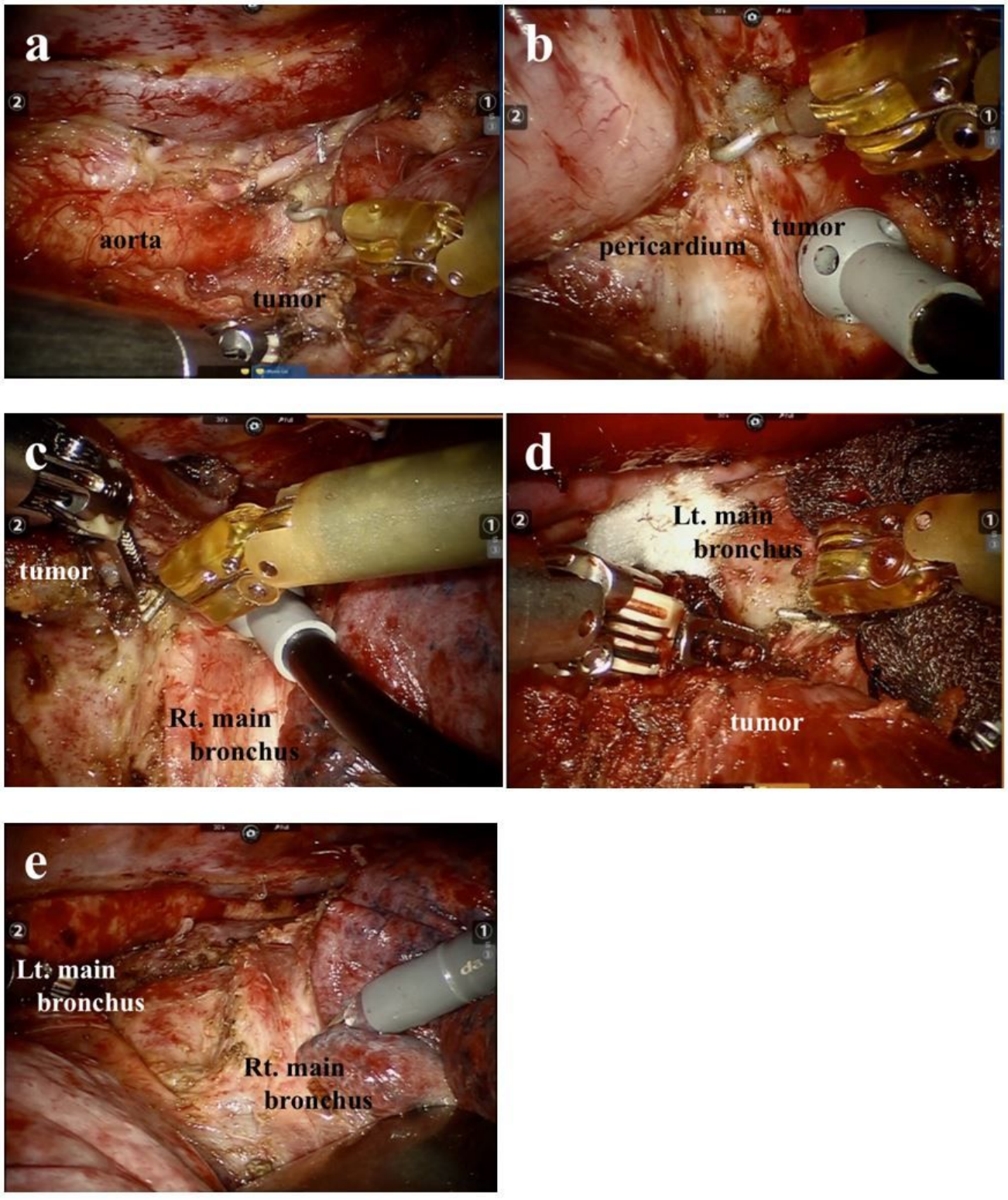

Figure 2

The right main bronchus, right inferior pulmonary vein, and pericardium were isolated from the scarred mediastinal tissue (a, b). A scarred tumor adhering to a lymph node was dissected from the left inferior pulmonary vein, left main bronchus, and pericardium (c, d, e). A very severe scar on the dorsal surface of the left main bronchus was separated through careful dissection using the RATE system.

Supplementary Files

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