Abstract
We describe a case of squamous cell carcinoma of the lung with invasion of the esophagus treated by radical en bloc resection as salvage surgery. Chest computed tomography showed a 46-mm tumor and a 25-mm subcarinal lymph node invading the esophagus. After three cycles of chemotherapy with cisplatin plus vinorelbine, the bronchoscopic findings revealed that the hemorrhagic tumor had progressed, and hemoptysis, cough and dysphagia were getting worse and proving very bothersome to the patient. To resolve his symptoms, we performed left pneumonectomy with esophageal resection and reconstruction. The esophagus was reconstructed via a posterior mediastinal route to use the greater omentum for coverage of the stump of the left main bronchus and the anastomosis of the reconstructed esophagus. Although he died of metastatic lung and brain tumors 18 months after the surgery, he was doing well more than one year after the operation. In addition, improvement of the respiratory and digestive symptoms was also achieved with complete resection.

Key words: salvage surgery, esophageal resection, esophageal reconstruction

Introduction
Chemoradiation therapy or chemotherapy is generally regarded as the gold standard for Stage III or IV non-small-cell lung cancer (NSCLC). However, salvage thoracic operations for locally advanced NSCLC occasionally performed under certain conditions, and might be effective for curative intent and palliative care. One issue that remains is how acceptable extended thoracic operations are for advanced NSCLC patients. We herein report a case of NSCLC that was treated by left pneumonectomy with esophageal resection and reconstruction to relieve severe respiratory and digestive symptoms due to lung cancer invasion after chemotherapy.

Case Report
A 57-year-old man was referred to our hospital due to productive cough and dysphagia. His medical history was significant for subarachnoid hemorrhaging and stroke from which he completely recovered. Laboratory data revealed CEA of 5.5ng/ml and SCC of 11.50ng/ml. Chest plain X-ray showed atelectasis of the left lower lobe (Fig. 1a). Chest computed tomography (CT) showed a tumor shadow 46mm in diameter in the left pulmonary hilum and a subcarinal lymph node 25mm in diameter adjacent to the esophagus (Fig. 1b, c). Video bronchoscopy showed a tumor at the left main bronchus and biopsy showed a squamous cell carcinoma of the lung. After three cycles of chemotherapy (cisplatin plus vinorelbine), the main tumor and the subcarinal lymph node had been reduced in size from 46 to 35mm and 25 to 15mm, respectively. However, upper gastrointestinal endoscopy revealed an irregularly shaped tumor at the mid-intrathoracic esophagus, and trans-esophageal endoscopic ultrasound (EUS) showed that the lung cancer had invaded the submucosa of the esophagus (Fig. 2a, b). Furthermore, the bronchoscope findings revealed that the
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A hemorrhagic tumor had progressed to a site approximately 3 cm from the carina. The patient's hemoptysis, cough, and dysphagia were getting worse and becoming very bothersome and we considered the risk of death by suffocation. Given these findings and the clinical course, we deemed that radical surgical treatment with esophageal resection and reconstruction would help control the patient's symptoms and give a favorable oncologic outcome.

During the operation, we found the subcarinal lymph node adherent to the left main bronchus and the esophagus. We proceeded with pneumonectomy and esophageal resection via thoracotomy. The caudal stump of the esophagus was cut with a surgical stapler above the diaphragm, and the cranial stump was cut at the upper thoracic esophagus. We then added an abdominal incision to construct the gastric tube and to insert a feeding catheter into the jejunum for post-operative nutrition management. The gastric tube with an omental patch was reconstructed by cutting along the lesser curvature, and the gastroepiploic arcade and the right gastric vessels were preserved. We returned to the chest operation and reconstructed the esophagus via a posterior mediastinal route (Fig. 3a, b). Finally, an omental patch was brought up to cover the stump of the left main bronchus and the anastomosis of the reconstructed esophagus (Fig. 3c).

Pathology showed well-differentiated squamous cell carcinoma of the lung, pT4N2M0, Stage III B. Although part of the tumor was exposed to the esophageal mucosal surface, the surgical margin was negative (Fig. 4a, b). The histopathological effect of chemotherapy was examined for E1-fa. The

Fig. 1 Imaging findings on admission. Chest plain X-ray showed atelectasis of the left lower lobe (a), and chest CT showed a tumor shadow in the left pulmonary hilum and a subcarinal lymph node 25 mm in diameter pressing the esophagus aside (arrow) (b, c).

Fig. 2 Upper gastrointestinal endoscopy and trans-esophageal EUS.; Upper gastrointestinal endoscopy revealed an irregularly shaped tumor of the mid-intrathoracic esophagus (a). Trans-esophageal EUS showed that the lung cancer had invaded the submucosal layer of the esophagus (b).
patient was recovered from the severe respiratory symptoms after the operation. As the patient needed to fast for 21 days for treatment of a minor leak from the anastomosis of the reconstructed esophagus, the placement of feeding tube into the jejunum played an important role for nutrition. Chest X-ray and CT after surgery showed no hyper-expansion of the right lung or mediastinal shift, but some degree of movement of the gastric tube to fill the space was noted (Fig. 5a, b). The patient was discharged 44 days after the surgery and received two cycles of adjuvant chemotherapy (carboplatin, vinorelbine). Eleven months after the surgery, the patient was found to have widespread metastasis at the right lung, brain, tongue, skin and bone. Eighteen months after the surgery, the patient died of metastatic lung and brain tumors.

Discussion
Salvage thoracic operations for locally advanced NSCLC are occasionally performed under certain conditions, and might be effective for curative intent and palliative care. Uramoto stated that salvage thoracic operations, in a wide sense, can be defined as surgical resection of persistent or recurrent primary lung tumors after previous treatments, in addition to urgent matters such as hemoptysis. Some reports have indicated that salvage thoracic operations after definitive chemoradiation are feasible with an encouraging survival rate, as the median progression-free survival (PFS) was 10.3–12 months with an overall survival (OS) of 30–32.5 months. Such surgery might therefore be considered a favorable treatment option for select patients. In the present case, after three cycles of chemotherapy, the...
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A hemorrhagic tumor had progressed so steadily that there was severe hemoptysis, cough and dysphagia with an exacerbating tendency, so we performed surgical resection in an emergency evacuation manner.

Salvage operations are often technically demanding, and are associated with increased risks because of adhesion and fibrosis due to prior treatment. Therefore, careful patient selection is required for salvage operations. A previous report identified the factors that might contribute to favorable results, including adequate preoperative staging, the ability to obtain an R0 resection and a good performance status. The present case was c-T4N2M0, Stage III B, and the tumor was localized in the left pulmonary hilum and combined with a bulky subcarinal lymph node invading the esophagus. The patient was relatively young, and his performance status was good. Radical en bloc resection and symptom control seemed to be attainable by performing pneumonectomy with esophageal resection and reconstruction.

One issue that remains is how acceptable extended thoracic operations are for advanced NSCLC patients as salvage surgery. Our operation method imposed a substantial burden on the patient. Therefore, we must carefully judge the operative indications. Weder et al. retrospectively reviewed the perioperative mortality, morbidity, and outcome of 176 pneumonectomies performed after induction chemotherapy or chemoradiotherapy for Stage III NSCLC. Most of the patients (138/176 or 78%) underwent some form of extended resection including esophagus wall resection (3 cases). They reported that the 90 postoperative day mortality rate was 3% and the morbidity rate 13%. Furthermore, Dyszkiewicz et al. reported that the early and late results of extended pneumonectomy in lung cancer patients with T3 and T4 disease. Thirty-seven patients without preoperative N2 involvement underwent extended pneumonectomy. Of these patients, one underwent the partial esophageal resection and anastomosis of the cut ends. They reported that the mortality rate was 6.8% and the morbidity rate 29%. These two reports suggest that extended pneumonectomy is justified by a relatively low mortality and morbidity rates in select patients.

In 2010, there were only 8 patients (0.02%) who underwent lobectomy or pneumonectomy with esophageal resection among all lung cancer operations in Japan. One report showed that the 5-year survival rate of these cases with esophageal resection was lower (12.5%) than that of the other cases of T4 NSCLC. However most of these patients underwent partial esophageal muscular layer resections and thus received incomplete resection. If the lesion invades deeply into the muscle layers of the esophagus or extrudes into the esophageal lumen, resection and reconstruction of the esophagus are indicated and may lead to a longer survival.

The best route of esophageal reconstruction is controversial. In our case, we selected a posterior mediastinal route because the greater omentum could be used for coverage of the end of the left

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Fig. 5 Chest X-ray (a) and CT (b) after surgery revealed no hyper-expansion of the right lung or the mediastinal shift but did show some degree of the movement of the gastric tube to fill the space.
main bronchus and the anastomosis of the reconstructed esophagus. However, in case at a risk of an anastomatic leakage, a pretersternal or a retrosternal route is a reasonable alternative.

We chose chemotherapy in light of concerns over rapid tumor necrosis causing a broncho-esophageal fistula or fatal hemorrhaging in such a large tumor, although concurrent or sequential chemoradiotherapy might be standard for Stage III B NSCLC. Sequential irradiation therapy was to be considered after the curative effect by chemotherapy alone had been evaluated; however, we had to perform salvage surgery given the emergency situation of the patient, with the possibility of the sudden death due to the exacerbation of the hemoptysis. Ultimately, distant metastases of the tumor developed within a year after the surgery. Local control of the tumor was possible, but the control of the distant metastases remained unresolved. As a result, we should have more aggressively performed adjuvant chemotherapy in order to improve the metastasis control.

Trans-esophageal EUS was useful for making a detailed evaluation of the esophageal invasion. We were able to identify localized tumor invasion into the submucosa of the esophagus. This finding helped us determine an operative strategy to achieve radical resection of the involved areas with sufficient surgical margins.

Conflict of interest: None.

References


