

Esophageal Stripping Creates a Clear Operative Field for Lymph Node Dissection along the Left Recurrent Laryngeal Nerve in Prone Video-Assisted Thoracoscopic Surgery

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Abstract

We describe a 54-year-old man in whom esophageal carcinoma was diagnosed and who underwent video-assisted thoracoscopic surgery of the esophagus (VATS-E) in the prone position. Initially, the patient was fixed in a semiprone position, from which he could be rotated to a prone or left lateral position. Four ports were inserted, and then the patient was rotated to the prone position. Once the patient was prone, gravity caused the lung to move downwards. Next, the chest cavity was inflated with a CO₂ insufflation pressure of 6 mm Hg. Esophagectomy was then performed, and the lymph nodes in the middle and lower mediastinum and along the right recurrent laryngeal nerve were dissected. In the left upper mediastinum, lymph node dissection was performed after the residual esophagus was stripped. Stripping of the residual esophagus created sufficient working space and a clear operative field for lymph node dissection. VATS-E in the prone position has achieved remarkable results in Japan. It allows a clear operative view of the middle and lower mediastinum, but the working space in the upper mediastinum is limited. Our results indicate that esophageal stripping in prone VATS-E allows for safe and straightforward lymph node dissection along the left recurrent laryngeal nerve. Our technique overcame the difficulties usually encountered with this type of lymph node dissection.

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Key words: video-assisted thoracoscopic surgery of the esophagus, prone position, stripping

Introduction

Left lateral video-assisted thoracoscopic surgery of the esophagus (VATS-E) has been adopted by Japanese medical centers and university hospitals

that frequently treat patients who have esophageal cancer¹. Recently, some investigators, including Palanivelu et al, have reported that a clear operative field could be obtained in prone VATS-E owing to the working space created by gravity and pneumothorax²⁻⁴. However, in the upper left

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mediastinum, retraction of the esophagus toward the spine is more difficult in the prone position than in the left lateral position, and the working space for dissecting the lymph nodes along the left recurrent laryngeal nerve is limited. We formerly performed lymph node dissection along the left recurrent laryngeal nerve after the patient had been rotated from the semiprone to left lateral position. Although the working space in the upper left mediastinum is usually created by rotating the trachea, as reported by Noshiro et al⁵, we used a retractor to move the trachea. However, the esophagus interfered with lymphadenectomy near the neck. We overcame this difficulty by stripping the residual esophagus. Thus, we obtained a clear operative field in the upper left mediastinum with the patient in the prone position, enabling safe and straightforward lymph node dissection along the left recurrent laryngeal nerve. We describe our VATS-E method in the present report.

Case Report

The patient was a 54-year-old man who was referred to our hospital for treatment of an esophageal tumor measuring 4.0 cm in length (**Fig. 1**). The patient had no chief complaint or notable past or family history. On admission, he had no concomitant illness. Blood biochemistry on admission, including tumor markers, was unremarkable. Esophageal carcinoma was diagnosed based on findings of upper gastrointestinal endoscopy. The carcinoma was located in the middle third of the thoracic esophagus. Barium swallow radiography and computed tomography (CT) of the chest and abdomen found no signs of metastasis. Treatment with VATS-E was selected because of the absence of invasion to other organs.

Our VATS-E method is as follows. To permit easy retraction of the esophagus, a soft tracheal tube (Smiths Medical, St. Paul, MN, USA, or Fuji Systems Corp., Tokyo, Japan) is inserted into the trachea and bronchus before the procedure for one-lung anesthesia.

The patient is initially placed in the semiprone position to allow for rotation to the prone or left

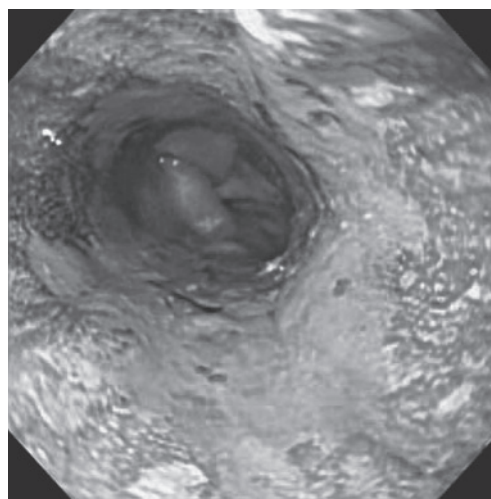


Fig. 1 Endoscopy showed a nearly circumferential lesion unstained with iodine which was diagnosed as a flat-elevated type of superficial carcinoma in the lower third of the esophagus.

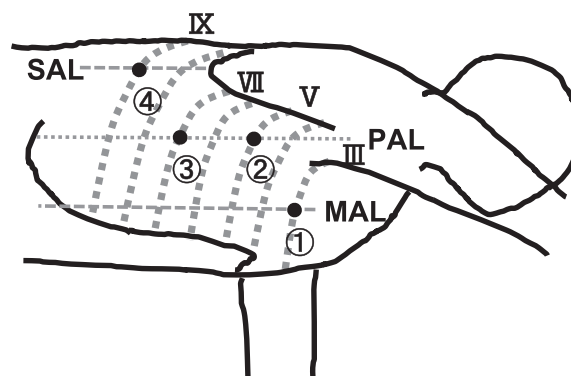


Fig. 2 Four open ports were created for the thoracoscopy and endoscopic instruments. The ports were inserted in the third intercostal space (ICS) on the midaxillary line ①, the fifth ICS on the postaxillary line ②, the seventh ICS on the postaxillary line ③, and the ninth ICS below the scapula angle line ④.

lateral position. In cases of emergency thoracotomy, the patient is rotated from the semiprone position and the procedure is performed in left lateral position. The patient is immobilized with a Magic Bed (Nikko Fines Industries, Tokyo, Japan) and side panels. The ProneView protective helmet system (Dupaco, Oceanside, CA, USA) protects the patient's eyes and the bronchoscopy could be inserted through the hole of the ProneView.

Four 5- or 12-mm ports are inserted at the third intercostal space (ICS) behind the midaxillary line, the fifth and seventh intercostal spaces on the

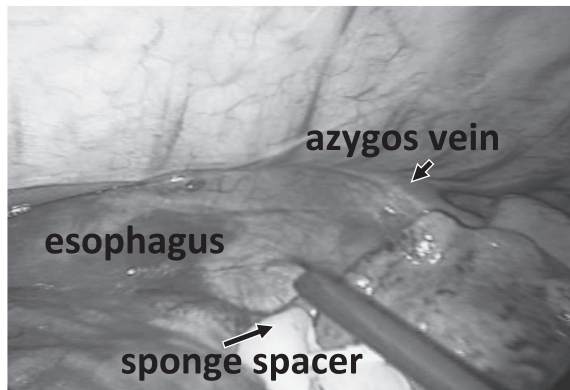


Fig. 3 Esophagectomy using a sponge spacer (arrows).

posterior axillary line, and the ninth intercostal space on the scapular angle line (**Fig. 2**), and the chest cavity is inflated via the ports by means of a CO₂ insufflation pressure of 6 mm Hg (**Fig. 3**).

For esophagectomy, the patient is rotated to the prone position. The endoscope is usually inserted through the ninth ICS, and tissue is ablated if lung adhesion is present. A sponge spacer (Securea, Hogy Medical Co., Ltd., Tokyo) is used to compress the lung and stretch the pleura, after which the mediastinal pleura is cut along the inferior pulmonary ligament. The Securea sponge spacer, which Nakamura et al. developed with Hogy Medical Co., Ltd., is a medical device that can be effectively employed for many purposes⁶. A sponge spacer is inserted into the space between the esophagus and aorta, and the lymph nodes along the esophagus and in the posterior mediastinum are dissected. After the proper esophageal arteries are isolated and cut following double clipping, the esophagus can be moved away from the aorta and pericardium. The working space created by gravity and pneumothorax allows for easy dissection of lymph nodes above the diaphragm. The esophagus around the hiatus is isolated, after which the hiatus is opened. We isolate and cut the azygos arch after performing double ligation at both ends, and the thread at the back side is retracted using the Endo Close, thread retracting device (Covidien, Mansfield, MA, USA). The right bronchial artery is preserved.

Lymph nodes around the trachea and bronchus are dissected while they are still attached to the esophagus, if possible.

First, we identify the right vagus nerve and right inferior subclavian artery, which allows us to determine whether the right recurrent laryngeal nerve is separate from the right vagus nerve. Lymph nodes and fatty tissue are removed from the right vagus nerve and the right inferior subclavian artery, after which lymph nodes along the right recurrent laryngeal nerve are dissected.

The esophagus in the upper mediastinum is separated from the trachea, vertebrae, and thoracic duct. In cases of advanced esophageal carcinoma, the thoracic duct should be resected while attached to the esophagus. The esophagus is isolated, and both the esophagus and stomach tube in the esophagus of the upper mediastinum are cut away from the tumor using Echelon Flex Endopath Staplers (Ethicon Endo-Surgery, Cincinnati, OH, USA) (**Fig. 4a**). After the stomach tube is removed through the nose, the residual esophagus is stripped in the reverse direction and retracted toward the neck (**Fig. 4b**). This stripping technique was previously demonstrated in an animal model to be straightforward and safe (**Fig. 4c**).

Working space is created in the upper mediastinum by compressing the right main bronchus with the Securea device after the trachea is rotated, after which a retractor is used to move the trachea toward the right while the patient is in the prone position. Stripping the esophagus results in a clear view and large working space in the left upper mediastinum. The lymph nodes and fatty tissue are ablated from the left edge of the trachea, after which the lymph nodes along the left recurrent laryngeal nerves are dissected without interfering with the cardiac nerve. With this method lymphadenectomy can be performed along the left recurrent laryngeal nerve, without obstruction from the residual esophagus, and at sites close to the neck (**Fig. 4d**). As the left recurrent laryngeal nerve is followed, the lymph nodes under the aortic arch are dissected and the left vagus nerve is identified.

After lavage of the chest cavity, both cut ends of the esophagus are connected using vessel tape. A chest drain is inserted via the seventh port hole, and the other port wounds are closed.

We perform cervical and abdominal manipulations

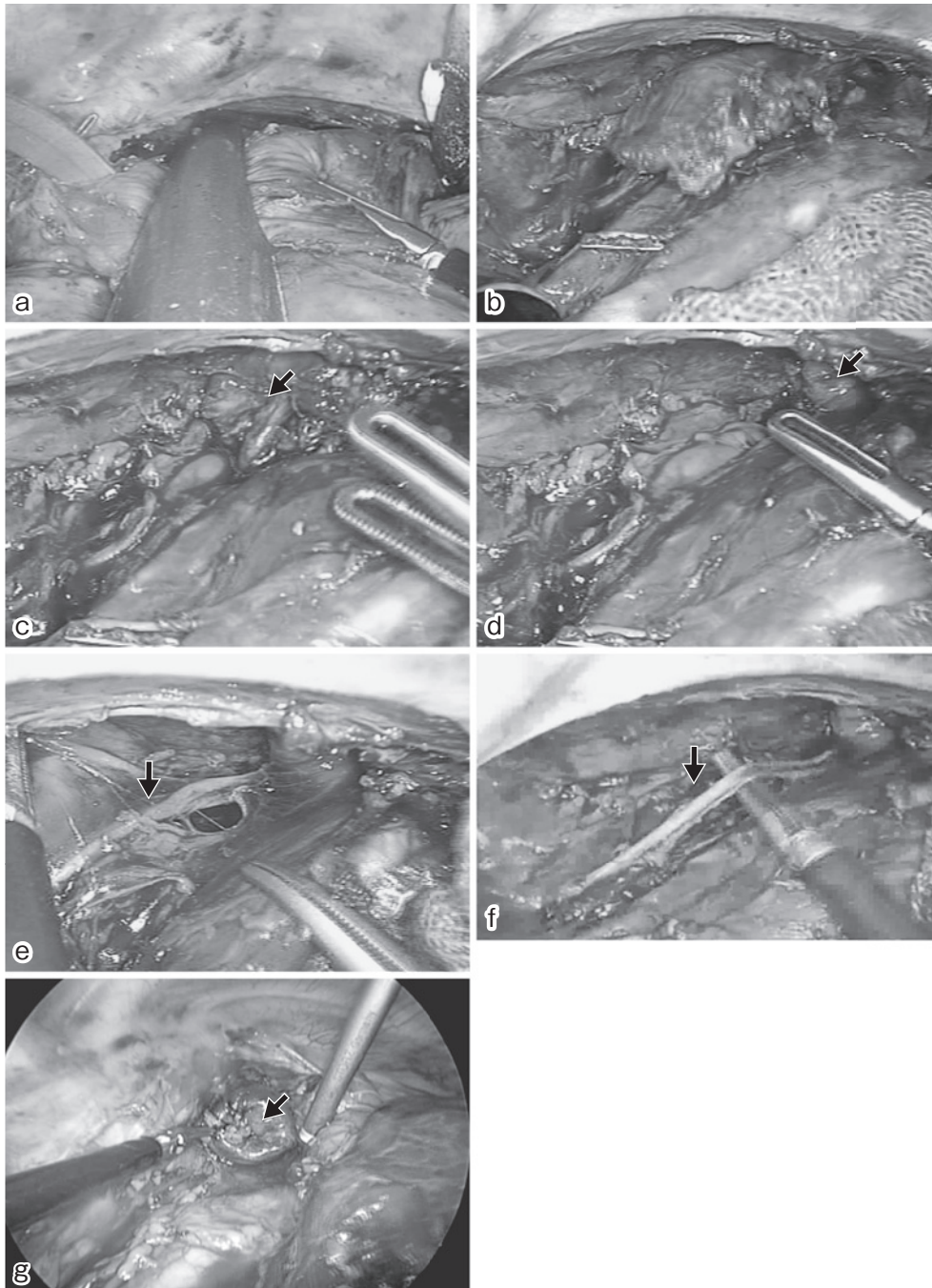


Fig. 4

- a. Both the esophagus and stomach tube in the esophagus of the upper mediastinum are cut away from the tumor using Echelon Flex Endopath Staplers.
- b. The left upper mediastinum after cutting the esophagus. We usually perform lymph node dissection along the left recurrent laryngeal nerve in this field and retract the trachea toward the right with the patient in the prone position.
- c. The residual esophagus is stripped by pulling the shortened stomach tube (**arrow**) in the upper mediastinum.
- d. Almost all the residual esophagus (**arrow**) is retracted in the reverse direction toward the neck.
- e. Lymph node dissection along the left recurrent laryngeal nerve (**arrow**) after stripping of the residual esophagus.
- f. The left recurrent laryngeal nerve (**arrow**) after lymph node dissection.
- g. The stripping technique (**arrow**) was previously verified as straightforward and safe in an animal model.

with the patient in the supine position. The laparoscopy-assisted or open technique is used to create the gastric conduit and to dissect abdominal lymph nodes. In the neck, we perform lymph node dissection along both recurrent laryngeal nerves using the Kent boomerang retractor⁷. The residual esophagus and gastric conduit are pulled up to the neck via the posterior mediastinal route.

In the present case, esophagogastrostomy was performed after the esophagus had been cut to the correct length. The patient received artificial ventilatory support after the procedure, and the endotracheal tube was removed 2 days after surgery when the respiratory state was considered stable. The coughing reflux was sometimes weak because of the lymph node dissection in the upper mediastinal area. Nonetheless, the endotracheal tube could be removed after the absence of bilateral recurrent laryngeal nerve paralysis had been confirmed.

The patient's course was uneventful. Although enteral nutrition was delayed due to paralysis of the left recurrent laryngeal nerve, he began eating on postoperative day 26.

Discussion

Left lateral VATS-E requires a highly skilled operator, first assistant, and endoscopist. The first assistant must move the lung to obtain a clear operative field. Left lateral VATS-E has been adopted by a small number of hospitals that frequently treat patients with esophageal cancer^{1,4,8,9}. In Japan, the results of prone VATS-E have been favorable. This approach has the additional advantage of lessening the technical demands on the first assistant because the working space is created by gravity and pneumothorax¹⁻⁴. Moreover, prone VATS-E avoids the blood pooling and effusion that can obstruct the operative field in left lateral VATS-E.

In an emergency thoracotomy, if the patient is initially placed in the semiprone position, he/she is then rotated from to left lateral position. Intraoperative bronchoscopy can be performed with the patient in the semiprone position. Because prone VATS-E allows for stable respiration and circulation,

it has been adopted by many hospitals¹⁰.

Some surgeons, mainly from the East, believe that extended 3-field lymph node dissection with aggressive esophagectomy provides a survival benefit in cases of squamous cell carcinoma of the thoracic esophagus because of the high frequency of metastasis to lymph nodes along the recurrent laryngeal nerves. Methods for lymph node dissection along the recurrent laryngeal nerves in the prone position have been reported by Palanivelu et al. and Noshiro et al., although Western surgeons rarely describe lymph node dissection along the recurrent laryngeal nerve^{1-4,8,9}.

In the present case, with the patient in the prone position we were unable to obtain a good working space for lymph node dissection along the left recurrent laryngeal nerve; the working space was secured by retracting the esophagus with the patient in the left lateral position. Initially, the lymph nodes and fatty tissue surrounding the left recurrent laryngeal nerve were ablated from the left edge of the trachea. It was necessary to exercise great care while dissecting the lymph nodes along the left recurrent laryngeal nerve, so as to avoid injuring the nerve or trachea in the narrow space surrounding the trachea and esophagus. An early-term lymph node dissection along the left recurrent laryngeal nerve was performed nearly entirely in the left lateral position by rotating the patient from the semiprone position. Noshiro et al⁵ have reported that a working space in the left upper mediastinum could be obtained by rotating the trachea. We needed only retraction sufficient to move the trachea toward the right while the patient was in the prone position to perform the lymph node dissection along the left recurrent laryngeal nerve before using our technique. All these methods require the use of an instrument to move the esophagus. However, esophageal stripping to avoid the esophagus in lymph node dissection is not necessary, but it is easier and more effective than other methods. With our technique, the residual esophagus can easily be pulled up to the neck after sufficient ablation. Stripping of the rectum for resection has also been reported in some studies as a means to move the digestive tract. In one report,

Koizumi et al have described how the thread used for suturing the abdominal site can be pulled from inside the rectum without using stripping wire¹¹. These methods can be applied to esophageal stripping, but our method is simpler because the residual esophagus can be stripped by pulling out the residual stomach tube. It is also more sanitary, as there is no communication with the lumen of the digestive tract.

When the VATS-E procedures is performed in Japan, recurrent laryngeal nerve paralysis occur in 10% to 15% of cases^{1,5,8}. In the present study, paralysis of the left recurrent laryngeal nerve occurred but was transient. The left recurrent laryngeal nerve was isolated before stripping, and we could perform radical and accurate lymph node dissection. We are hopeful that the frequency of paralysis along the left recurrent laryngeal nerve will decrease.

Conclusion

Prone VATS-E is of interest to many esophageal surgeons, as it affords a clear view and is associated with a good clinical course. However, because it allows only a small working space in the left upper mediastinum, its has only slowly been accepted. We believe that our technique addresses this limitation and should result in wider adoption of prone VATS-E.

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