Video-assisted radical thoracoscopic and laparoscopic surgery for esophageal carcinoma

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ABSTRACT Esophageal cancer is a common malignancy, for which surgery is the most effective treatment. Compared with traditional surgery, video-assisted thoracoscopic and laparoscopy minimally invasive surgery enables less trauma, better visibility, reduced bleeding and postoperative pain, and lower incidence of surgical complications through a minimally invasive, safe, and highly cost-effective approach in favor of early rehabilitation after surgery. Therefore, the promotion and application of this surgical approach will undoubtedly benefit the majority of patients with esophageal cancer. We have performed video-assisted thoracoscopic and laparoscopy minimally invasive surgery for more than 150 patients in our hospital to date, and have carried out a series of studies in this regard. As the video shows, this approach is safe and reliable with minimal injury and bleeding.

KEYWORDS Esophageal cancer; thoracoscopy; laparoscopy

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Introduction

Radical esophageal resection is one of the most effective means for the treatment of esophageal cancer. In traditional surgery, resection of the esophagus is conducted under direct vision, followed by dissection of the lymph nodes around the esophagus and reconstruction of the digestive tract. It is limited by extensive surgical injury, and a higher incidence of postoperative complications and mortality. Video-assisted thoracoscopic surgery (VATS) has been improving since its first successful application in the treatment of esophageal diseases by Pellegrini in 1992. In 2000, Luketich *et al.* (1) first reported the combined use of thoracoscopic and laparoscopic surgery in the treatment of esophageal cancer. This minimally invasive surgical approach has ever since been increasingly recognized as it opened a brand new way for the surgical treatment of esophageal cancer. Foreign studies have confirmed that this approach is a genuinely minimally invasive surgical means with better outcomes in terms of blood loss, postoperative pain intensity and postoperative recovery time compared with traditional surgery (2-4).

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Procedure

This video (Video 1) shows the procedures of the radical thoracoscopic and laparoscopic surgery for esophageal carcinoma:

(I) The patient is first positioned in the left prone position. With one-lung ventilation, after the right lung collapses, a 10-mm trocar port is created in the 7th intercostal space at the posterior axillary line. The thoracoscopy is placed to identify the presence of pleural adhesions and tumor invasion. CO_2 is injected to maintain a pressure of 7 mmHg. A 12-mm working port is created in the 4th intercostal space at the posterior axillary line, a 12-mm secondary working port in the 9th or 10th intercostal space at the subscapularis line, and a 5-mm supporting port in the 7th intercostal space at the subscapularis line. The locations of the above ports will depend on the specific anatomical characteristics and the site of esophagus cancer. Using an ultrasonic scalpel, the inferior pulmonary ligament is cut through to the pulmonary vein to expose the pleura on the surface of the esophagus along its course. After endoscopic separation, the azygos vein is dually clamped with a Hem-O-Lok mechanism, and cut. The normal lower segment of the esophagus below the cancer is divided. Lifted with the aspirator, the esophagus is gradually exposed upwards to the top of the chest cavity and downwards to the diaphragmatic hiatus. Meanwhile, the mediastinal lymph nodes are dissected (around the trachea, lung ligament, around the esophagus, below the carina, and along the left and right laryngeal nerves). A chest tube is inserted through

Video 1. Video-assisted radical thoracoscopic and laparoscopic surgery for esophageal carcinoma.

the observation port, and a mediastinal drainage tube from the secondary working port. The operation ports are then closed one after another as the end of the VATS procedure.

(II) The patient is then placed in the supine position, with the head slightly skewed to the right, under lung ventilation. Pneumoperitoneum is created with CO_2 at an intra-abdominal pressure of around 15 mmHg. A 10-mm observation port is created inferior to the median umbilical position at the midline, one port at each side of the midclavicular lines 2 mm under the arch of ribs (10-mm for the left as the main working port; 5-mm for the right as a secondary working port), and one 5-mm port at each side of the umbilicus 6-8 cm away from it as supporting ports. After exploration of abdominal adhesions and the presence of metastases, the omentum tissue at the gastric antrum side is divided along the outer side of the gastroepiploic vessels, in which the gastrocolic ligament, left gastroepiploic vessels, short gastric vessels and pericardial blood vessel are separated respectively. With left hepatic lobe pulled, the lesser sac is opened to transect the hepatogastric ligament, with due care to retain the right gastric vessel. The stomach is then lifted the upper left region to reveal the left gastric vessels, along which the lymph nodes are dissected. The left gastric artery is clamped dually with Hem-O-Lok and transected. The posterior gastric and fundus blood vessels are then treated. The pleuroperitoneal membrane at the esophageal diaphragmatic hiatus is opened to complete the separation of the stomach.

(III) An incision is made to the leading edge of the left sternocleidomastoid neck, through which the cervical segment of the esophagus is separated and transected. A retraction suture is made. A 5-cm incision is made to the ventral midline to retract the esophagus and the stomach. The gastric vessels at the lesser curvature are treated. The esophagus and the stomach are transected at the cardia and the lesser curvature with a stapler. The stomach is made into a tubular stomach. With the stomach lifted to the neck level, routine gastroesophageal anastomosis (stapling with a stapler) is performed, followed by placement of a decompression tube and duodenal feeding tube through the nose. The incisions are then closed to end the surgery.

Discussion

In the treatment of esophageal cancer, esophageal resection is one of the most effective means. In traditional surgery, resection of the esophagus is conducted under direct vision, including three approaches from the left chest, right chest, and neck, chest and abdomen, respectively. All of them are associated with extensive surgical injury, high risks of postoperative complications, and high mortality rate, especially significant impact on the respiratory function. The incidence of postoperative pulmonary complications is as high as 20% to 40%, one of the main causes of death in the perioperative period (5). VATS has been improving since its first successful application in the treatment of esophageal diseases by Pellegrini in 1992. An increasing number of reports of VATS for various diseases are available, including esophageal cancer resection with VATS alone, VATS assisted small-incision esophageal resection, hand-assisted VATS resection of esophageal cancer, and so on. Since most VATS procedures are still associated with the removal of the stomach under direct vision, there are still risks of extensive surgical injury, postoperative pain and high incidence of postoperative pulmonary complications. With the improvement in the technology of surgeons and endoscopic equipment, laparoscopic removal of the stomach has been applied clinically. In 2000, Luketich *et al.* (1) first reported the combined use of thoracoscopic and laparoscopic surgery in the treatment of esophageal cancer. This approach preserved the intact structure of the chest and abdomen cavities with little impact on the respiratory function, which increased the postoperative recovery speed and significantly reduced the incidence of postoperative complications. This minimally invasive surgical approach has ever since been increasingly recognized as it opened a brand new way for the surgical treatment of esophageal cancer (3-6). Most domestic and foreign studies (7-11) have confirmed that VATS lymph node dissection is comparable to conventional three-incision thoracotomy. The key to successful video-assisted radical thoracoscopic and laparoscopic surgery, as presented in our video, lies in smooth and safe division, separation and bleeding control under the endoscope. For omentum or mesenteric vessels in the size of 3 mm or below, a 5-mm ultrasonic electrotome can be used to directly cut them off. For larger vessels such as the left gastric artery, the Hem-O-Lok mechanism provides more secure and reliable approach to clamping any artery or vein in a diameter of 7 mm or below. Reports at home and abroad have shown comparable incidence of esophageal anastomotic fistula,

chylothorax, hoarseness and other complications following VATS resection and conventional thoracotomy (12,13). The incidence of postoperative complications in our 150 cases undergoing the thoracoscopic and laparoscopic surgery is similar to that in previous reports (12,13). Chylothorax is often associated with larger tumors and thoracic duct injury during the separation. Therefore, when a larger tumor is present and injury to the thoracic duct is possible, the thoracic duct should be ligated. Hoarseness may occur as a complication due to injury to either of the recurrent laryngeal nerves during lymph node dissection. Therefore, blunt dissection is always preferred in this procedure, and the nerves should be clearly identified before lymph node dissection. In cases that cannot be treated with VATS, immediate switch to other surgical strategy or transition to thoracotomy will be necessary to avoid delayed surgery or compromised radical effect.

Conclusions

In short, the video-assisted radical thoracoscopic and laparoscopic surgery is technically feasible and safe, which provides satisfactory short-term outcomes with less injury, quicker recovery and fewer postoperative complications. Further observation will be needed on its long-term outcomes.

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