

Thoracoscopic and laparoscopic radical esophagectomy with lateral-prone position

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Abstract: With 20 years of development, minimally-invasive treatment for esophageal cancer has been widely spread. However, surgeons have not reached consensus about the optimal minimally-invasive operation method, or whether the effect of radical lymph nodes dissection is comparable to the traditional open procedure. Thoracoscopic esophagectomy with lateral-prone position combines the advantages of both lateral position (allowing quick conversion to open procedure) and prone position (good visual area and complete lymphadenectomy). Together with laparoscopic abdominal lymphadenectomy, gastric tube formation and jejunostomy, this approach provides an easier way for minimally-invasive radical esophagectomy. In this article, approaches for thoracoscopic esophagectomy with lateral-prone position and total mediastinal lymphadenectomy, combined with totally laparoscopic gastric mobilization, abdominal lymphadenectomy, gastric tube formation and jejunostomy, will be presented by video instructions. All the procedures were under the rule of radical lymphadenectomy. Cervical lymph nodes dissection and esophago-gastrostomy were the same as those in open procedure, which will not be discussed here.

Keywords: Minimally-invasive surgery; video-assisted thoracoscopic surgery (VATS); esophageal cancer; lateral-prone position



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Introduction

Esophageal cancer is one of the most malignant tumors threatening people's lives, and the 6th leading cause of cancer-related death worldwide. China is the high incidence area for esophageal cancer, with more than half of the patients with esophageal cancer in the world (1). Squamous cell carcinoma is the most common type for esophageal cancer, with main causes of death of post-operative lymph nodes recurrence and metastasis. Therefore, three-field lymphadenectomy involving neck, thorax and abdomen is highly suggested for its improved long-term survival rates, but it is also limited for its high rate of morbidity and mortality (2). Minimally-invasive surgeries employing thoracoscopic and laparoscopic techniques are widely performed over the past 20 years. According to the reports of Luketich *et al.* (3) in 2003 and Palanivelu *et al.* (4) in 2006, minimally-invasive

esophagectomy (MIE) has the same long-term survival rate but less post-operative complications and higher survival quality of life compared with open procedures. These advantages have made MIE widely-spread and adopted in more and more cases (5,6) over the last decade.

MIE is an approach which combines thoracoscopy, mediastinoscopy and laparoscopy, however, which combination is optimal is still under discussion. Even more, whether radical lymph nodes dissection is fully completed as in open procedure is still under doubt (7).

In this article, main steps of thoracoscopic esophagectomy with lateral-prone position and total mediastinal lymphadenectomy, combined with totally laparoscopic gastric mobilization, abdominal lymphadenectomy, gastric tube formation and jejunostomy will be introduced, in order to reach the target of minimally-invasive radical esophagectomy,



Figure 1 Thoracoscopic access at the end of the surgical procedure.



Video 1 Denudation of arch of azygos vein.



Video 2 Lymphadenectomy of right para-recurrent laryngeal nerve for intraoperative frozen section.

both thoracoscopically and laparoscopically.

Thoracoscopic esophagectomy with lateral-prone position and total mediastinal lymphadenectomy

Patient was intubated with single-lumen endotracheal tube, with lateral-prone position of 45 degree leaning to the left. Thoracoscopic observation port (12 mm) was placed at middle axillary line at the sixth intercostal space, inflated with CO₂ at 6-8 mmHg, collapsing right lung lobe. During operation, tidal volume can be properly lowered by anestheologist in order to better expose posterior mediastinum. Main operative port (5 mm) was placed at the right side of middle axillary line at the fourth intercostal space. Assisting port (12 mm) was place 2 cm behind the right side of the posterior axillary line at the eighth intercostal space (*Figure 1*). Esophagus mobilization and mediastinal lymph nodes dissection were successively done.

- (I) Chest exploration, adhesion separation and azygos vein ligation. Mediastinal pleura in the posterior side of esophagus is incised to ensure the resectability of tumor (*Video 1*);
- (II) Lymph nodes at the right side of para-recurrent laryngeal nerve were dissected and sent for intraoperative fast frozen pathological diagnosis, in order to decide whether three-field lymphadenectomy would be employed in patient's cervical area (8) (*Video 2*);
- (III) Supra-diaphragmatic lymph nodes and fat tissue were then dissected and thoracic duct was ligated. Lower esophagus was mobilized and tied with tractor, in order to better reveal the left side of mediastinum (*Video 3*);
- (IV) Esophagus, para-esophageal lymph nodes and subcarinal nodes were resected en bloc from distal to proximal end until thoracic inlet. Lymph nodes at the left side of para-recurrent laryngeal nerve and aortopulmonary window lymph nodes were further dissected (*Video 4*).

The lateral and prone positions are commonly employed in the thoracoscopic esophagectomy. The former goes in line with the visual habit of both open and video-assisted thoracoscopic surgery (VATS), facilitating multiple procedures, which needs veteran assistants to help reveal detailed structures, and affects lymph nodes dissection by restricting the exposure of the left side of mediastinum. The latter provides better exposure for the left side of mediastinum, thus complete lymphadenectomy



Video 3 Dissect the anterior diaphragmatic lymph nodes, mobilize lower esophagus and tie with tractor.



Video 5 Mobilization of greater gastric curvature.



Video 4 Mobilization of the thoracic esophagus.



Figure 2 Laparoscopic access at the end of the surgical procedure.

is ensured. However, the visual habit differs from that of the traditional open procedure, which requires operator's accommodation. Another weak point for prone position is that patient's position should be shifted if conversion to open surgery is needed. Considering pros and cons of both positions, the author suggests esophagectomy be performed with lateral-prone position and total mediastinal lymphadenectomy, which can be an approach for thoroughly resecting thoracic esophagus and dissecting total mediastinal lymph nodes, as proved in 130 cases of study. Apart from that, advantages such as single-man operation, better exposure of the left side of mediastinum and more complete lymph nodes dissection are also significant. Moreover, immediate conversion to open procedure could be possible, especially when intraoperative bleeding occurs.

Totally laparoscopic gastric mobilization, abdominal lymphadenectomy, gastric tube formation and jejunostomy

Patient was reset to supine position, with head higher above feet and 30 degree leaning to the right. Incisions were made traditionally with five ports (see *Figure 2*). Gastric mobilization, abdominal lymphadenectomy, gastric tube formation and jejunostomy were performed in sequence.

- (I) Great curve was separated up to gastro-splenic ligament and down to pyloric (*Video 5*);
- (II) Lymph nodes located in common hepatic artery, splenic artery, celiac trunk and para left gastric artery were dissected (*Video 6*);
- (III) Gastric tube formation (*Video 7*);
- (IV) Jejunostomy (*Video 8*);



Video 6 Lymphadenectomy at lesser gastric curvature.



Video 9 Tubular stomach pulled-up.



Video 7 Tubular gastroplasty.



Video 10 Suture of diaphragmatic hiatus.



Video 8 Jejunostomy.

- (V) Esophageal hiatus was mobilized, and the gastric tube was lifted to the neck (*Video 9*);
- (VI) Diaphragm hiatus was sutured to prevent post-operative diaphragm hernia (*Video 10*).

All the above six steps were performed laparoscopically.

Laparoscopy was employed in esophagectomy as total laparoscopy and hybrid laparoscopy. The latter was less difficult during operation, with higher safety and shorter operation time, thus more widely adopted clinically. Total laparoscopy requires higher techniques such as suturing for formation of gastric tube and jejunostomy, but provides smaller trauma. By experience of 130 cases, the author believes total laparoscopy, compared with open procedure, can provide the same therapeutic effect of gastric mobilization and lymph nodes dissection, and safe gastric

tube formation and jejunostomy.

Conclusions

Thoracoscopic and laparoscopic radical esophagectomy and esophago-gastrostomy with lateral-prone position is a reliable approach to treat esophageal cancer. Comparing with open procedure, this approach provides the same lymphadenectomy but less surgical trauma and post-operative complications, as well as improved post-operative quality of life.

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