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Original Research

Long-term outcomes of minimally invasive Ivor Lewis esophagostomy for esophageal squamous cell carcinoma: Compared with open approach

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HIGHLIGHTS

- Minimally invasive Ivor Lewis Esophagostomy reduce postoperative complications comparing to conventional open surgery.
- This research provided a long-term follow up study of patients receiving MI-ILE in comparison with those underwent O-ILE.
- Our pouch-string forceps reinforced MI-ILE operation is safe and technically feasible with worth of clinical promotion.

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ABSTRACT

Objective: To investigate the safety and long-term efficacy of combined thoraco-laparoscopic minimally invasive Ivor Lewis esophagostomy(MI-ILE) in the treatment of esophageal squamous cell carcinoma.
Methods: The clinical data of patients with esophageal squamous cell carcinoma who underwent Ivor Lewis esophagostomy of esophageal cancer from October 2011 to June 2013 were retrospectively analyzed. Of which 90 patients received MI-ILE, 95 patients underwent open Ivor Lewis esophagostomy (O-ILE). The clinicopathological features, intraoperative records and incidences of postoperative complications of the two groups were compared with *t*-test and $\chi 2$ test. The primary end point of the study was 3-year disease-free survival (DFS) and 3-year overall survival (OS) was a secondary end point.
Results: There were no statistically significant differences in gender, age, preoperative comorbidities, American Society of Anesthesiologists score and position of the tumor between the two groups. There was also no significant difference in clinicopathological characteristics, operation time, length of tumor resection margin and number of resected lymph nodes between the two groups ($P > 0.05$). In MI-ILE group, the blood loss was lower than in the O-ILE group [(159.1 + 97.4) ml vs. (191.7 + 141.9) ml, $t = 1.811$, $P = 1.811$]and the postoperative hospital stay was shorter [(11.5 + 4.5) d vs. (13.9 + 6.2) d, $t = 2.944$, $P = 0.004$]. There was no significant difference in the incidences of perioperative mortality and major morbidities ($P > 0.05$). Minor complications including incision infection rate (1.1% vs 8.4%, $\chi 2 = 3.873$, $P = 0.049$) and pulmonary infection incidence (3.3% vs 11.57%, $\chi 2 = 4.492$, $P = 0.034$) is lower in MIILE group. There was no significant difference in 3-year disease-free survival (DFS) and 3-year overall survival (OS) between the two groups.
Conclusion: MI-ILE is a technically safe and feasible approach for esophageal squamous cell carcinoma treatment. The oncologic outcomes of MI-ILE are comparable to that of O-ILE 3 years after resection.

1. Introduction

Minimally Invasive Ivor Lewis Esophagostomy (MI-ILE) operation shows the advantage of minimal invasion comparing to the conventional open Ivor Lewis approach (O-ILE), with competitive short-term therapeutic effect. However, the long-term outcome of MI-ILE operation on tumor control and patients' survival hasn't been fully explored. To investigate the long-term efficacy of MI-ILE operation, we retrospectively analyzed the clinical

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records and the follow-up results of 90 patients receiving MI-ILE operation together with 95 patients receiving conventional O-ILE operation for esophagostomy from October 2011 to June 2013 in our department.

2. Material and methods

2.1. General information

90 patients meeting the MI-ILE grouping criteria were selected to the MI-ILE group, and 95 patients to the O-ILE group. The grouping criteria for MI-ILE group was: patient's preoperative clinical stage was T1~3 N0~1 M0, according to 2009 AJCC TNM staging criteria, with squamous carcinoma located in middle or lower esophagus; tumor tissue was removed by MI-ILE operation in alliance with modern two-field lymphadenectomy; no neoadjuvant chemoradiotherapy were applied preoperatively. Except for receiving scheduled open surgery instead of MI-ILE for tumor removal, the grouping criteria for O-ILE group was the same as that for MI-ILE group to minimize bias in case selection and thus make the two groups comparable.

All patients have preoperatively received enhanced thoracic-abdominal CT scanning, upper gastrointestinal contrast imaging, electronic gastroscopy supplemented with pathological examination, electrocardiography, pulmonary function test and other routine tests. Patients over 65 years old or diagnosed with cardiovascular complications also received cardiac color doppler ultrasonography and left ventricular function test. Complications were classified according to the Clavien-Dindo grading system. Clavien-Dindo grade 1 and 2 were considered minor complications, and grade 3–5 considered major complications. Preoperative clinical data of patients assigned to the two groups were compared in Table 1.

Each MI-ILE or O-ILE surgery was performed by 5 surgeons, each of whom has surgical experience of more than 100 cases of MI-ILE and O-ILE surgery and has passed homogenized training in surgical process and techniques.

2.2. Surgical method of MI-ILE

Following intratracheal intubation anesthesia using double lumen tube, patient was set to supine position with chief surgeon on the right side of the patient. The five-hole method was applied for abdominal operation (Fig. 1A): incision below naval was inserted with 10 mm Trocar for laparoscopic operation and CO_2 pneumoperitoneum establishment; incision on the cross point of right clavicular midline and the horizontal line 3 cm above naval was inserted with 10 mm Trocar as primary operating hole. Three other incisions, one on the cross point of left clavicular midline and the horizontal line 3 cm above naval, one on right clavicular midline below the right costal margin, and one below xiphoid process, were inserted with 5 mm Trocar, respectively, as secondary operating holes.

After routine check for abdominal or liver metastases, lesser gastric curvature was released from lesser omentum by ultrasonic scalpel dissection, and left gastric artery was exposed followed by Hem-*o*-lok clipping (Fig. 1B). Gastro-pancreatic fold was dissected to expose left and right diagram pars. Left gastroepiploic artery and short gastric artery from the greater gastric curvature were separated (Fig. 1C), and the lower esophagus was partially released. Lymph node resection around preventriculus, left gastric artery, lesser and greater curvature of the stomach, common hepatic artery, splenic artery and celiac artery was performed intraoperatively.

An incision about 4 cm in length was made along the upper abdomen midline, starting from the operating hole below xiphoid process. Lower esophagus was amputated at preventriculus, and the stomach was pulled out from the incision to make a tubular stomach using linear stapler under direct vision(Fig. 1D). Gastric fundus was immobilized to lower esophagus with silk threads. The incision below xiphoid process was roughly closed, and other incisions were sutured.

The patient was then set to left lateral position with one-lung ventilation on the uninjured side and chief surgeon on the abdomen side. The three-hole method was applied for thoracic operation (Fig. 2A): an incision about 4–5 cm at the 4th intercostal on the anterior axillary line was made as primary operating hole; an incision about 1 cm at the 7th intercostal on the midaxillary line was made for thoracoscopic operation; an incision about 1.5 cm at the 7th or 8th intercostal between posterior axillary line and scapular line was made as secondary operating hole.

The arch of azygos vein was dissociated and amputated after Hem-*o*-lok clipping (Fig. 2B). Esophagus between right thoracic apex and esophageal hiatus was released, and lymph nodes around esophagus, subcarinal, recurrent laryngeal nerve on both sides, cavity-air gap and above diaphragm were resected.

Purse string suture was performed close to the upper end of the mid-esophagus using purse-string forceps inserted through the primary operating hole (Fig. 2C). Esophagus above the purse string suture was cut open, into which the end effector of the esophagogastric anastomat was inserted. The purse string was then tightened by assistant through the secondary operating hole to fix the end effector. The middle and lower esophagus were then excised.

The tubular stomach was pulled out into thoracic cavity through esophageal hiatus. Gastric fundus was cut open to insert the anastomat for intrathoracic esophagogastric anastomosis (Fig. 2D). Linear stapler was used for endoscopic stump closure of the tubular stomach.

Thoracic drainage tube was indwelled through the thoracoscopic operating hole, and latex draining tube was indwelled through the secondary operating hole with its tip located 2 cm below the anastomotic site. Gastric tube and duodenal feeding tube were indwelled through the incision below xiphoid process, and all

Table 1
Comparison of preoperative clinical data of cases in MI-ILE and O-ILE group.

	Gender (male/female)	Age	Tumor location (middle/lower esophagus)	Preoperative complications			ASA physical status classification		
				cardiac-cerebral vascular diseases	Respiratory disease	Type-II diabetes	I	II	III
MI-ILE	68/22	62.9 ± 8.3	87/3	13	8	5	23	49	18
O-ILE	73/22	63.9 ± 8.5	90/5	12	8	6	26	50	19
$\chi 2$	0.042	0.787	0.808	0.130	0.013	0.048	0.086		
ρ	0.837	0.433	0.777	0.718	0.910	0.827	0.958		