Single-port minimally invasive esophagectomy

Jen-Hao Chuang, Shun-Mao Yang, Pei-Wen Yang, Pei-Ming Huang, Jang-Ming Lee

Department of Surgery, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan

Correspondence to: Dr. Jang-Ming Lee. 7, Chung-Shan South Road, Taipei, Taiwan. Email: ntuhlee@yahoo.com.

Abstract: With the growing evidence of clinical benefit of minimally invasive esophagectomy (MIE) combined video-assisted thoracoscopic surgery (VATS) and laparoscopy procedures, we describe how these procedures can be performed with single-incision both in the abdominal and thoracic phases. Clinical observation of the midterm results has demonstrated its feasibility and benefit of relieving postoperative pain. However, the long-term impact on the survival of the patients requires to be evaluated in the future.

Keywords: Esophageal cancer; minimally invasive esophagectomy (MIE); single-incision minimally invasive esophagectomy (SIMIE)

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Introduction

As minimally invasive esophagectomy (MIE) combining laparoscopic and thoracoscopic procedures has gradually accepted as a feasible approach in treating esophageal cancer (1-9), we describe our experience using a single-incision thoracoscopic and laparoscopic approach for treating esophageal cancer which has been published for the first time in literature before (10).

Patient selection

The selection criteria for SIMIE (single-incision MIE) included: (I) no evidence of tumor invasion to the adjacent organ in imaging studies (excluding T4 disease) or no previous history of abdominal or thoracic surgery; (II) one-lung ventilation can be tolerated during surgery. Informed consent has been obtained from the patients.

Operative procedures

Esophagectomy and mediastinal lymph node dissection

With the patient in a lateral position, a 3–4 cm incision is created through the sixth or seventh intercostal space on the mid-axillary line. The angle between the axes of the oesophagus and surgical instrumentation must be kept in excess of 30° to facilitate a smooth dissection for the area near the right recurrent laryngeal nerve area.

Surgical exposure under single-portal thoracoscopy

When patient in lateral decubitus position, the posterior mediastinum and its underlying esophagus would be covered by posterior aspect of right upper lobe and right lower lobe, which makes them unable to be approached directly, especially when lung collapse is not optimal. To help the exposure of the surgical fields, several retention stitches over the boarder of esophagus and fixed extra-corporally to prevent to hindrance of lung to the surgical field (10). The azygous vein is at first divided followed by mobilization and looping of the esophagus. When doing Ivor-Lewis procedure, distal esophagus end can be grasped and pulled upward to enhance mobilization of the esophagus after division of the gastric tube, and looping of the esophagus is not recommended.

Mediastinal esophageal mobilization and lymphadenectomy (Figures 1,2)

Esophageal mobilization and lymphadenectomy along the esophagus, para-tracheal and bilateral recurrent laryngeal nerves is performed. The vagus nerve is identified before dissection of the para-tracheal and right recurrent nerve region to avoid its injury as well as help preservation of
right recurrent laryngeal nerve during the procedure of lymph node dissection. *Figure 1* demonstrates the process of esophageal mobilization and partial pericardiectomy due to focal tumor invasion after neoadjuvant chemoradiation. *Figure 2* demonstrates the procedure of lymph node dissection along the left recurrent laryngeal nerve with aids of tenting of mobilized esophagus for a better exposure of the surgical field.

**Gastric mobilization under single-portal laparoscopy (**Figure 3**)**

During the laparoscopic procedure, a 3-cm incision is made along the umbilicus and retracted with a surgical wound-protector (GelPoint, Applied Medical, CA, USA), which allows the use of two or three surgical instrument and a 5- or 10-mm camera in the procedure (10). A self-retaining fixing stitch passing through the diaphragmatic hiatus and tightened extra-corporally is used for retraction of liver (10). The stomach is mobilized via opening the greater and lesser sac along the greater and lesser curvature and dividing short and left gastric arteries are divided with ultrasonic or bipolar scissors. Lymph nodes in the hiatus, lesser curvature, left gastric and celiac trifurcation are dissected after gastric mobilization. A feeding jejunostomy was performed on the jejunum 40 cm from the Treitz ligament unless the patient had already had the procedure done prior to CCRT. The jejunum was fixed onto the abdominal wall through two stitches of preionization through strait needle and extra-corporeal fixation. A 12# Fr central venous catheter was placed into the lumen of jejunum and completed with two more stitches of preionization. The detail procedure of laparoscopic jejunostomy was done as our previous published paper (14).

**Completion with esophagogastronomy**

**Tri-incision esophagectomy**

Followed by thoracic procedure, the patients were shifted to supine or lithotomy position for both abdominal and cervical procedures. The gastric conduit and cervical esophagus were anastomosed over left cervical area through either posterior mediastinal or substernal route.

**Ivor-Lewis esophagectomy (**Figure 3**)**

For the Ivor-Lewis approach, a DST OrVil circular staple with the anvil introduced transorally is used to perform the
intrathoracic esophagogastrostomy. After opening the tip of
gastric tube, two retaining stitches were made on the edge
of tip opening to allow the introduction of the PCEEA
applier. After completion of the esophagogastrostomy by
approximation of both end of PCEEA, the defect of gastric
tube was closed with linear stapler. The sharp end of the
staple lines on the stomach and esophagus was reinforced
and inverted into the esophageal and gastric lumen to make
the stapling surface smooth to avoid injuring to the adjacent
organ by the exposed stapling metals. Figure 3 demonstrate
the procedure of Ivor-Lewis procedure from the abdomen
to the chest. The procedure of tri-incision procedure,
including the esophageal as well as gastric mobilization and
lymphadenectomy is similar to that of Ivor-Lewis only with
different sequence from the chest to the abdomen.

Discussion

According to our preliminary experience, MIE can be
effectively performed with single-port approach either
in the Ivor-Lewis or tri-incision surgery. With the aids
of long and thin surgical instrumentation and stich-aid
tenting of the adjacent organs, the surgical procedures can
be performed as that done in the multi-incision surgery.
As our previously published results, the perioperative and
oncological outcome of SIMIE was similar as compared
to that done by multport-MIE (10). The pain scores on
the 7th day after surgery were significantly lower in the
SIMIE group than in the MIMIE group. Whether these
findings can be translated into a better quality of life or
patient satisfaction requires to be evaluated in the future.
Especially, the clinical value for the long-term outcome
after surgery for esophageal cancer remained to be clarified
with the accumulation of more clinical experience and more
well conducted clinical studies.

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part was performed for this patient due to focal invasion of tumor to the pericardium.

Footnote

Conflicts of Interest: The authors have no conflicts of interest
to declare.

Informed Consent: Written informed consent was obtained
from the patient for publication of this manuscript and any
accompanying images.


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