

## Laparoscopic / Thoracoscopic Ivor Lewis Esophageal Resection for Cancer (Report of Two Cases and Review of the Literature)

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**Abstract:** Open esophagectomy may be associated with significant morbidity and mortality. With the increasing experiences in laparoscopic and thoracoscopic techniques, minimal invasive approaches to esophagectomy are being explored to determine the feasibility, results, and potential advantages.

We will present our experience in two cases of laparoscopic / thoracoscopic Ivor Lewis esophageal resection for carcinoma of the lower esophagus. The presentation of the two cases, their surgical approach and postoperative course will be discussed in addition to literature review of similar cases.

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### Introduction

Although minimal invasive esophagectomy have been reported since 1992<sup>[1]</sup>, it is still considered to be investigative in most institutions. It has the potential to improve mortality, morbidity, hospital stay, and functional outcome when compared to the open methods<sup>[2]</sup>. It is expected that with further improvements in instrumentation and experience, these difficult procedures may become more accessible and widely practiced.

### Case 1

A 55-year-old male was presented with a history of progressive dysphagia to liquid and solid foods for six months. In addition, the patient also reported generalized fatigability, loss of appetite and weight loss of about 10 kg over a period of three months before seeking medical advice. He was diabetic and smoker for 30 years. There was no significant family history of cancer.

Physical examination was unremarkable apart from significant weight loss.

Routine blood investigations were normal. Plain chest films were unremarkable. Upper gastrointestinal endoscopy revealed a malignant stricture at the lower part of esophagus starting at 35 cm below the dental arch which could not be passed by the endoscope. Multiple biopsies were taken which showed adenocarcinoma of the lower esophagus.

Computerized tomography (CT) scan of the thorax and abdomen with oral and intravenous contrasts revealed a circumferential thickening at the distal end of the esophagus with a mass extending to the gastric fundus with no mediastinal and para aortic lymphadenopathy nor distant organ metastases.

The patient was operated in February 2009 where laparoscopic / thoracoscopic Ivor Lewis esophagectomy with mini right thoracotomy was performed. The duration of the abdominal dissection was 4.5 hours, and the thoracic dissection was 3.5 hours. Total blood loss was 240 ml (Table 1). The patient stayed overnight in the Intensive Care Unit (ICU) and were transferred to the ward the following day. A gastrograffin study was done on the third postoperative day and showed intact anastomosis (Fig. 10). Oral nutrition was started on fourth postoperative day, and was discharged on fifth postoperative day. Histopathology was showed a well to moderately differentiated adenocarcinoma, and both gastric and esophageal margins were negative for tumor involvement. The tumor involved full thickness of muscularis propria, 3 mm away from the deep margin; the maximum tumor size was 9 cm with no lymphovascular invasion. There was intestinal metaplasia in the adjacent esophageal mucosa. Two out of ten mediastinal lymph nodes were positive for tumor metastasis. Consequently we evaluated the tumour in stage III, pT3pN1M0. The patient was submitted to adjuvant chemo radiotherapy, which was well tolerated and is still alive up to this report .

### Case 2

A 53-year-old male was presented with a history of progressive dysphagia to liquid and solid foods for 5 months. The patient also reported loss of appetite and weight of about 15 kg over a period of two months before seeking medical advice. He had no significant past medical or surgical history. He was a smoker for more than 30 years. There was no significant family history of cancer.

Physical examination was unremarkable apart from significant weight loss.

Routine blood investigations were normal. Plain chest films were unremarkable. Upper gastrointestinal endoscopy revealed esophageal mass at 30 cm below the dental arch and extended to the cardia of the stomach. Multiple biopsies were taken which showed adenocarcinoma of the lower esophagus.

CT scan of the thorax and abdomen with oral and intravenous contrasts revealed a circumferential thickening at distal part of the esophagus extending to the fundus of the stomach with one sub diaphragmatic lymph node, there was no mediastinal lymph node enlargement.

The patient was operated in June 2009 where laparoscopic / thoracoscopic Ivor Lewis esophagectomy with mini right thoracotomy was performed. The duration of the abdominal dissection was 3.5 hours, and the thoracic dissection was 2.5 hours. Total blood loss was 200 ml (Table 1). The patient stayed overnight in the Intensive Care Unit (ICU) and was transferred to the ward the following day. A gastrograffin study was done on the third postoperative day and showed intact anastomosis. Oral nutrition was started on fourth postoperative day, and was discharged on fifth postoperative day. Histopathology was showed a well differentiated adenocarcinoma, and the tumor size was 6 cm. Both gastric and esophageal margins were negative for tumor deposit. The tumor involved full thickness of the muscularis propria, 3 mm away from the deep margin with no lymphovascular invasion. Fourteen lymph nodes were identified and all were negative for tumor deposition (Tumor in pathologic stage II b,pT3pN0M0). The patient was submitted to adjuvant chemo radiotherapy, which was well tolerated and is still alive up to this report .

## Operative Technique

### 1) Abdominal part:

The operative procedures done for both patients were the same. Patient was placed in supine position with legs apart. Five ports were inserted at the upper abdomen as shown in figure (1). One 11-mm port is used in right epigastrium for access for stapling devices to create the gastric tube. The left lobe of the liver was retracted upward to expose the esophageal hiatus using self-retaining system. The laparoscopic dissection starts by dividing the hepatogastric ligament toward the right crus of the diaphragm. The right crus was exposed and dissected from the top of the hiatus to the decussation with the left crus. This plane was developed then cephalad along the left crus to develop a retro-esophageal window and a penrose drain was passed around the esophagus and used for

retraction (Fig. 2). The dissection was directed toward the mid to upper great curve just outside of the gastroepiploic arcade and was directed cephalad toward the short gastrics were all divided. The plane along the greater curve was developed and continued distally, care was taken to avoid injury to the major gastroepiploic arcade as it constitutes the major source of blood flow to the gastric tube (Fig. 3). Dissection was continued along this plane dividing the connecting vessels to the omentum. Care should be taken to preserve enough tissue to keep a healthy arcade without leaving too much tissue that will result in excessive bulk of tissue on the gastric tube lead to tension on the arcade or make it difficult for the gastric tube to ascend through the hiatus along the left crus. The dissection along the greater curve continues toward the hepatoduodenal attachments. These were divided along the lateral duodenum and gallbladder area to complete the Kocher maneuver. The greater curve is lifted and all the retro-gastric attachments were divided, the left gastric vascular complex including vein, artery, and lymph nodes were dissected, and the vessels were divided using an endoscopic vascular stapler (Endo-GIA II, U.S. Surgical). An area just above the first 2 to 3 arcades of the right gastric artery into the pyloro-antral area was chosen for firing the first stapler (Fig. 4). The vascular load was used here to minimize bleeding. The first few arcades of the right gastric vessels into the pyloroantral area were spared and the stapler is fired in a perpendicular orientation to the lesser curve. As the construction of the gastric tube continues, care was taken to align the stapler parallel to the greater curve arcade. we continue to apply gentle stretching of the stomach as the tube was constructed. Once the gastric conduit was completed, a pyloroplasty was performed. The muscle was divided open along the length of the pyloric channel. The pyloric incision was closed transversely using nonabsorbable 2-0 sutures. Next, mobilization at the hiatus into the thoracic cavity, in a circumferential manner was performed. The tip of the gastric tube was sewn to the lower end of the lesser curve staple line on the side of the specimen. The gastric tube was assessed for viability and adequate tension-free length.

### 2) Thoracic part:

The patient was positioned on the operating table in a left decubitus after he was intubated with double lumen endotracheal tube. Four ports were inserted in the right hemithorax as shown in figure (5). Following port placement, a thorough thoracoscopic exploration was performed. For the dissection, we used the ultrasonic dissecting instrument with a relatively sharp tip (U.S. Surgical); which was an

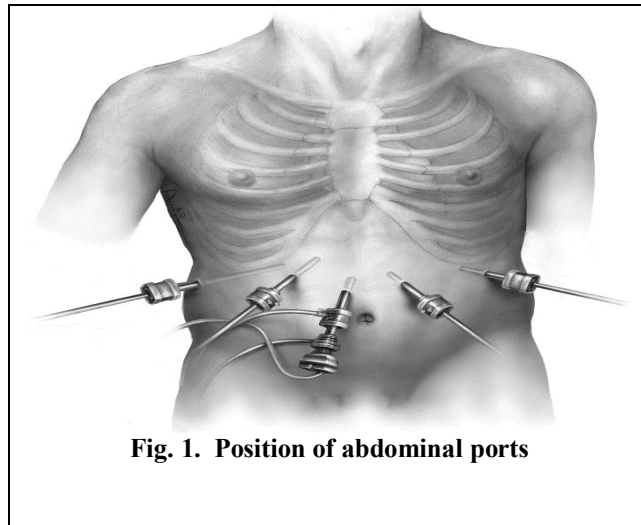
excellent dissecting tool. The inferior pulmonary ligament was divided to the inferior pulmonary vein and a plane between the pericardium and periesophageal area was developed (Fig. 6). All lymph nodes and periesophageal fat were taken en bloc with the esophagus. The dissection plane continued along the pericardium and airway, contralateral pleura, aorta, azygos vein, and thoracic duct. The mediastinal pleura along the esophagus was opened toward the azygos vein and extended from the azygos vein to the diaphragm. A penrose drain was passed around the esophagus and used for retraction. The azygos vein was divided (Fig. 7) using a vascular stapler (Endo-GIA II, U.S. Surgical). Above the level of the azygos vein, the dissection plane was maintained directly onto the esophageal wall (Fig. 8). This plane was continued cephalad toward the thoracic inlet. The subcarinal lymph node packet and all surrounding peri-esophageal nodes, fat, and hiatal hernia sac was dissected en-block with the esophagus down to the diaphragmatic crus. The distal dissection continues until visualization of the crus has occurred. The assistant or surgeon can retract the esophagus anterior to posterior

periodically to allow a circumferential view as the dissection was performed. Careful dissection and visualization of aorto-esophageal vessels should be performed and larger branches clipped before division to minimize bleeding.

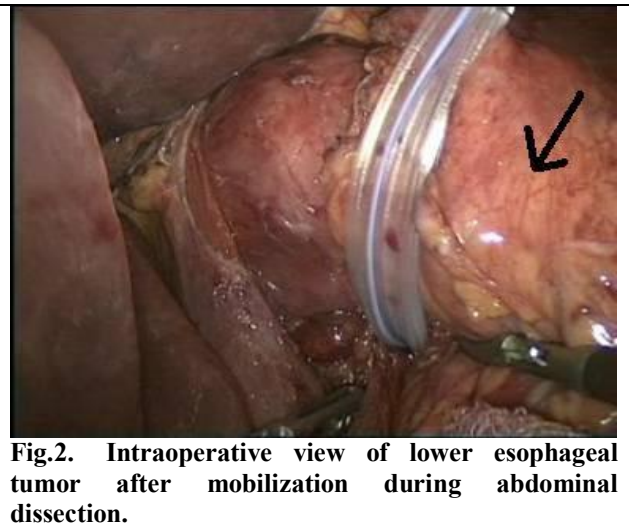
The esophagus was transected and a 25-mm EEA anvil was inserted into the esophageal stump; then the purse string was tied. The fundic tip was opened and a 25-mm end-to-end stapler (EEA, U.S. Surgical) was passed through the chest and this opening and the exit point of the EEA was through the posterior gastric tube, avoiding the area of the short gastrics posteriorly and avoiding too close a proximity to the lesser curve staple line (Fig. 9). The EEA device was docked with the anvil and fired. A nasogastric tube was inserted under direct visualization across the anastomosis and the tip should lie in the gastric tube above the pyloroplasty. The opening in the tip of the gastric tube was closed with a linear stapling instrument. A 4-5 cm mini thoracotomy was performed to remove the specimen and two chest tubes were inserted and all the port sites were closed by sutures.

**Table 1. Summary of the perioperative findings of Cases 1 and 2**

	Age (year)	Sex	Operative Time (hour)		Blood Loss (ml)	ICU Stay	Total Hospital Stay (Day)
			Abdominal Dissection	Thoracic Dissection			
Case 1	55	Male	4.5	3.5	240	1	5
Case 2	53	Male	3.5	2.5	200	1	5
Mean	54		4	3	220	1	5



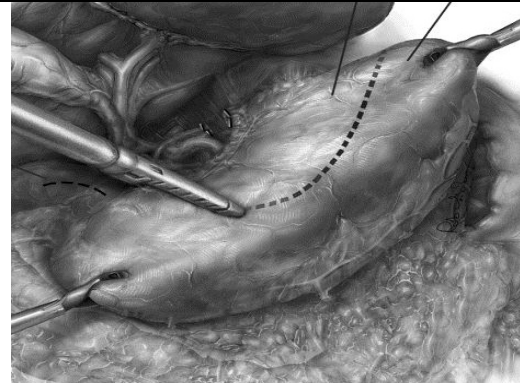
**Fig. 1. Position of abdominal ports**



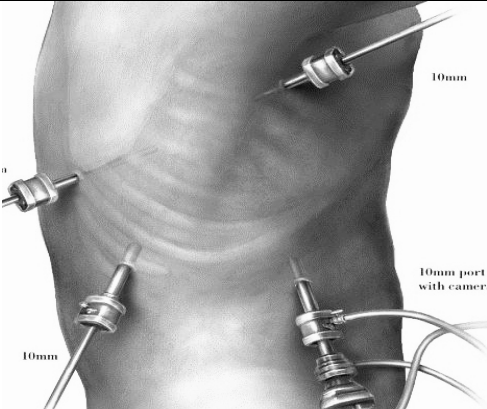
**Fig.2. Intraoperative view of lower esophageal tumor after mobilization during abdominal dissection.**



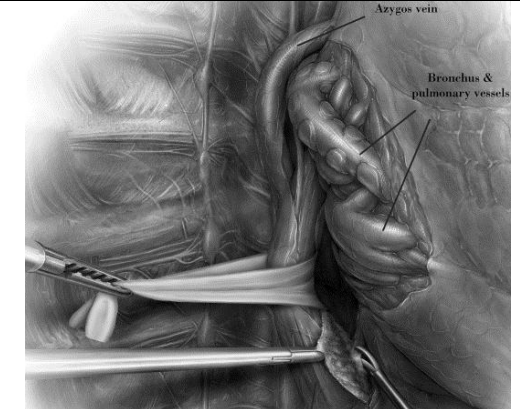
**Fig. 3. Dissection of gastroepiploic arcade**



**Fig. 4. Creation of gastric tube**



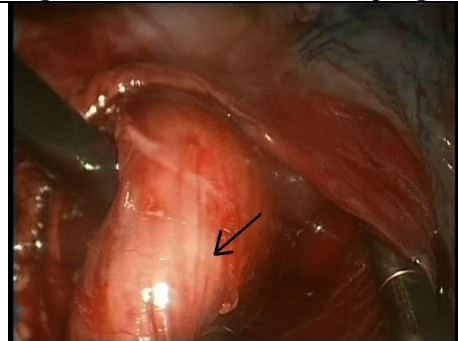
**Fig. 5. Position of thoracic ports**



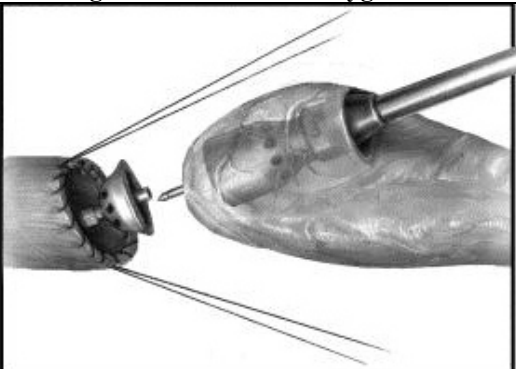
**Fig. 6. Dissection of thoracic esophagus**



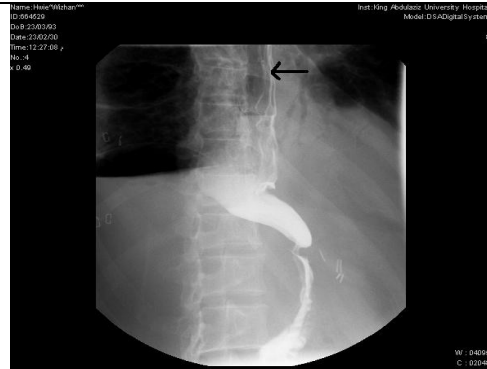
**Fig. 7. Transection of azygos vein**



**Fig. 8. Intraoperative view of upper esophagus after mobilization during thoracic dissection**



**Fig. 9. Gastroesophageal anastomosis in the upper part of the thorax**



**Fig. 10. Postoperative gastrograffin swallow of the same patient.**

## Discussion

In an attempt to lower morbidity of the open esophageal resection for cancer, some centers have explored Minimally Invasive Esophagectomy (MIE). The potential benefit of this technique is to improve the pain control and pulmonary function by avoiding synchronous thoracotomy and laparotomy incisions. Recently, several series have described the feasibility and safety of minimally invasive Ivor Lewis oesophagectomy. The extent of minimally invasive techniques has ranged from a laparoscopic abdominal component with a thoracotomy or mini-thoracotomy, to a thoracoscopic thoracic component and an open abdominal procedure<sup>[3,4]</sup>.

We used a minimally invasive abdominal and thoracoscopic technique with mini thoracotomy component in both of our patients during minimally invasive Ivor Lewis oesophagectomy. MIE using combined laparoscopic and thoracoscopic approach has the potential to offer an oncologically complete operation, while taking advantage of the benefits of minimally invasive surgery, which may translate into less overall morbidity. Recent data from other publications also suggests that lymph node yields may be improved, although insufficient data exist at this time to comment on oncologic results or outcomes with this technique<sup>[5,6]</sup>. On the other hand, MIE is technically a very challenging operation with a very steep learning curve and is only performed in few centers across the world.

The published experience with minimally invasive Ivor Lewis esophagectomy has been limited to case reports and small case series. The use of thoracoscopy and/or laparoscopy for esophageal resection was introduced in 1992 by **Cushieri et al**<sup>[7]</sup>. The first report of laparoscopy combined with thoracotomy was published in 1996 by **Jagot et al**<sup>[8]</sup>. In this series, six patients underwent laparoscopic mobilization of the stomach combined with a right thoracotomy and intrathoracic anastomosis. There were no conversions to an open procedure and all patients had an uneventful recovery. The first description of a complete minimally invasive approach was reported in 1999, when **Watson et al.**<sup>[9]</sup> described two patients where a hand-assisted laparoscopic approach was combined with a thoracoscopic anastomosis. There was no report of complications. Recently, **Nguyen et al.** described a total of three patients who had completely laparoscopic procedure combined with a thoracoscopic anastomosis<sup>[10]</sup>. All the three patients had an uneventful postoperative course.

To date, there is no controlled comparative trial between open esophagectomy and MIE. **Nguyen et al.**<sup>[10]</sup> compared 18 thoracoscopic and laparoscopic resections with their historical experience on open

resections. Operative times, blood loss, transfusion requirements, ICU and hospital stays were shorter after MIE but without any difference in fistula or respiratory complication rates.

Review of the literature from 1992 to 2007 showed 609 patients underwent laparoscopic and thoracoscopic esophageal resection for cancer<sup>[11,12]</sup>. Conversion rate was 4.7%, operative time was between 220 and 550 minutes (mean 350), hospital stay was between 6.5 and 16 days (mean 9), mortality 2.4 to 18% (mean 14%), over all morbidity 43%, respiratory complication 16.7%, re-operative rate 8.3%, vocal cord paralysis 3.1%, anastomotic leaks 9%, number of lymph nodes retrieved were between 9 and 48 (mean 16.5), and duration of follow up was between 3 and 32 months (mean 23)<sup>[12,13]</sup>. Other reported complications of MIE were chylothorax, tracheo-bronchial tears or necrosis, massive bleedings, splenectomies, visceral injuries (pancreas, colon). As many of the studies stated that they reported only "major" complications, the incidence of common surgical complications such as surgical site infections or thromboembolic complications was not mentioned by most of the series and thus no reliable incidences could be calculated<sup>[14,15]</sup>.

There was no morbidity or mortality in our two patients. The mean operative time was 4 hours for the abdominal dissection and 3 hours for the thoracic dissection and anastomosis, mean blood loss was 220 ml, mean ICU stay was 1 day, mean hospital stay was 5 days, and mean follow up was 1 year (Table 1).

In conclusion, laparoscopic / thoracoscopic Ivor Lewis esophagectomy is feasible. It reduces hospital stay and perioperative morbidity with quick postoperative recovery. There is a need for more prospective studies to compare the open esophagectomy with laparoscopic esophageal resection regarding the overall morbidity, mortality and the oncological outcome. We have found that it is a safe technique with preliminary results. Although very feasible, it should not be attempted without sufficient training and should be carried out only in specialized medical centers and by surgeons with adequate experience with open esophagectomy.

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