# MINIMALLY INVASIVE THREE STAGE ESOPHAGECTOMY FOR SQUAMOUS CELL CARCINOMA ESOPHAGUS; OUR TECHNIQUE WITH REFERENCE TO A CASE REPORT

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**ABSTRACT Introduction:** Esophageal cancer ranks 8th among the most common malignancies. Management of esophageal cancer is complex and involves multidisciplinary team approach. Esophagectomy is a complex procedure with significant morbidity. Surgical approach to esophagus depends on a lot of factors like the anatomical location of the disease in the esophagus, histopathology, desired lymphadenectomy and surgeon preferences. Historically the approach to esophageal resection was via open surgery. Minimally invasive surgery has revolutionized the management of esophageal surgery. Concept of Minimally invasive esophagectomy (MIE) was introduced to lessen the morbidity associated with open surgery. Less surgical trauma and hence less injury and inflammation are thought to play vital part in reducing the surgical stress and associated morbidity. Minimally invasive three stage esophagectomy is carried out for tumors of upper and middle esophagus, hence mostly for squamous cell carcinomas as they predominate in this region. **Methods:** We report a case of carcinoma esophagus that was managed by minimally invasive three stage esophagectomy. At our institute, Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMHRC) we routinely perform minimally invasive esophagectomy. We perform the thoracic part first in left lateral position via Video Assisted Thoracoscopic Surgery (VATS) approach, then the patient is placed in modified LIoyd Davis position and the abdominal part is performed via laparoscopic approach and simultaneously neck is dissected and later anastomosis is fashioned in the neck. **Results:** Patient underwent the procedure safely and was discharged on day five after surgery. It was an adequate oncological resection. **Conclusion:** Minimally invasive three stage esophagectomy is a safe procedure with less morbidity and equal oncological outcomes in high volume centers.

**KEYWORDS** Esophageal cancer, Esophagectomy, Minimally invasive esophagectomy, Video assisted thoracoscopic surgery, Laparoscopy

## Introduction

Esophageal cancer ranks eighth among the most common cancers worldwide [1]. The incidence of esophageal cancer is highest in China in the world with an incidence of 22.14 per 100000 persons-year [2]. Management of esophageal cancer is complex and involves multidisciplinary team approach. The management has continuously evolved over the previous few years. Surgery is still the cornerstone for the management of esophageal cancers. Esophagectomy is a complex procedure


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with morbidity and mortality in range of 25-30% and 2-8%. High volume centers report better figures with morbidity and mortality specially in China.

Esophagectomy requires two or three-field access depending on preoperative staging, location and histology of the lesion and most importantly the fitness of the patient. The concept of three field excess was introduced by McKeown [3]. In order to decrease overall morbidity and better patient recovery several centers have introduced the concept of minimally invasive three stage esophagectomy which aims at decreasing the surgical trauma and inflammation and hence better surgical outcomes [4,5]. Law and colleagues reported series of thoracoscopic mobilization for esophageal cancer [6]. First reported by Cusheri et al. in 1992 minimally invasive esophagectomy has undergone significant advancements [7,8]. The major advantage is less post-operative pulmonary infection [9]. This is of paramount importance as respiratory infections are most common morbidity after three stage esophagectomies and cause significant morbidity and mortality [10,11]. In this article we present the procedure of minimally invasive three stage esophagectomy that is undertaken at our institute.

## Methodology

**Patient selection and workup:** Our patient, a 35-year-old male, resident of Afghanistan presented to the outpatient department of Shaukat Khanam Memorial Cancer Hospital and Research Center (SKMH&RC) with complains of dysphagia and weight loss for six months. He underwent upper gastrointestinal endoscopy (Figure 1) and biopsy which conformed the diagnosis of squamous cell carcinoma middle third of esophagus, simultaneously percutaneous endoscopic gastrostomy (PEG) tube was passed for future nutritional support. It was followed by CT scan (figure 1b) that concluded a T3N1 mid esophageal tumor (AJCC classification eighth edition). Endoscopic ultrasound (Figure 1c) (EUS) was performed that complimented the findings of the CT scan. Positron emission tomography (PET) scan was performed that confirmed primary esophageal tumor without any metastasis. The patient was discussed in multi-disciplinary tumor board meeting and decision for neoadjuvant chemoradiotherapy followed by assessment for surgery was made. The patient completed neoadjuvant chemoradiotherapy was again staged with CT scan and was referred for surgical assessment.

**Pre-Operative preparation** Patient had pre-operative nutritional assessment by nutritionist before admission to the surgical floor and routine medical workup. He was admitted on surgical one day prior to surgery and incentive spirometry (ISM) was started by respiratory therapist. Blood arrangements made and operative technique explained with the aid of a diagram and models. Informed consent was obtained.

**Equipment preference card** We use dedicated high definition laparoscopy suite with two screens. For access we use 5mm,11mm and 12 mm ports with insufflation cuffs. LigasureTM Maryland dissector, Enseal® device and L hook cautery for dissection. Alexis TM wound protector for specimen extraction and conduit formation via small upper midline incision. Echelon staplers and Hem-O-lock clips are used.

**Procedure**

After induction of general anesthesia with double lumen tube and invasive monitoring lines such as arterial lines and thoracic epidural catheters left lateral position is being made and table breaking is done for adequate positioning for thoracoscopy. Right lung is being deflated and flexible bronchoscopy is being performed by the anesthetist to check the position of the double lumen endotracheal tube.

**First Stage (Thoracoscopic)**

Four port thoracoscopy was performed. Two x 5mm ports, 1x 10mm and 1 x11mm ports were utilized. A10mm camera port was placed in the 7th intercostal space anterior to the midaxillary line. A 5mm working port was being placed in the 8th intercostal space two finger breadths posterior to the first camera port. Another 10mm port was placed in the fourth intercostal space adjacent to nipple. Last 5mm port was being placed in the sixth intercostal space just beneath the tip of the scapula that aids in retraction and manipulation for the surgeon. The surgeon stands on right side whereas the camera assistant and first assistant surgeon stand on the left side. Scrub nurse stands on right side with the equipment trolley.

After port placements, the deflated lung was retracted and the area of the tumor was visualized and general resectability was assessed. Inferior pulmonary ligament was mobilized up to the azygos vein and the esophagus exposed. Medial dissection was performed first (Figure Ia), followed by careful lateral dissection (Figure Ib) from adjacent aorta. Direct branches from aorta to esophagus were individually clipped to avoid troublesome hemorrhage. Azygos vein was divided by vascular stapler Figure Ic) and later dissection above azygos vein was performed that is critical and one needs to stay on esophagus to avoid injury to membranous trachea. The esophagus was mobilized up to the root of the neck (Figure Id), taking care to avoid injury to nearby major vessels. Adequate lymphadenectomy was performed at this stage (figure Ie), avoiding injury to vital closely placed structures. Inferiorly the esophagus was mobilized to hiatus after retracting the diaphragm with a sponge stick. After this step the whole thoracic esophagus was mobilized. We clip the thoracic duct if there is suspicion of injury to thoracic duct during the lateral mobilization of the esophagus. Routinely the thoracic duct is not ligated. Hemostasis is ascertained and chest drain was placed to suction followed by closure of chest cavity and the patient was moved to supine position.

**Second and Third Stages (Laparoscopic and neck incision)** Modified Lloyd Davis position was made for the abdominal part of the operation (Figure IIa). Abdominal cavity was approached by 4x5mm ports and 1x11mm camera port that was placed in infra umbilical manner (Figure IIb). Abdominal cavity was inspected for any metastasis and mobilization of the stomach was started. Pedicle of Right Gastroepiploic artery was identified and at all times it was carefully preserved during the mobilization of stomach. Lesser sac was opened and mobilization was progressed towards the spleen. Short gastric arteries were carefully taken care of with ligasure device staying midway between stomach wall and spleen as to prevent gastric injury or splenic infarction.

Adequate mobilization up to the Left crus was performed and then later mobilization was done along hepatoduodenal ligament. At this stage it is critical to identify any aberrant or replaced left hepatic artery. Right crus was approached and mobilized. However, it shall not be opened as at this stage pneumoperitoneum can be lost. Left gastric artery and vein were clipped at their origin and lymph nodes harvested (Figure IIc). Now both the crura are opened at this stage and the abdominal cavity was communicated to chest cavity and suction of chest drain was made off. Second team at this stage started the neck dissection. We use an oblique incision on left side of the neck (Figure IIe), after dividing the platysma and dissection along

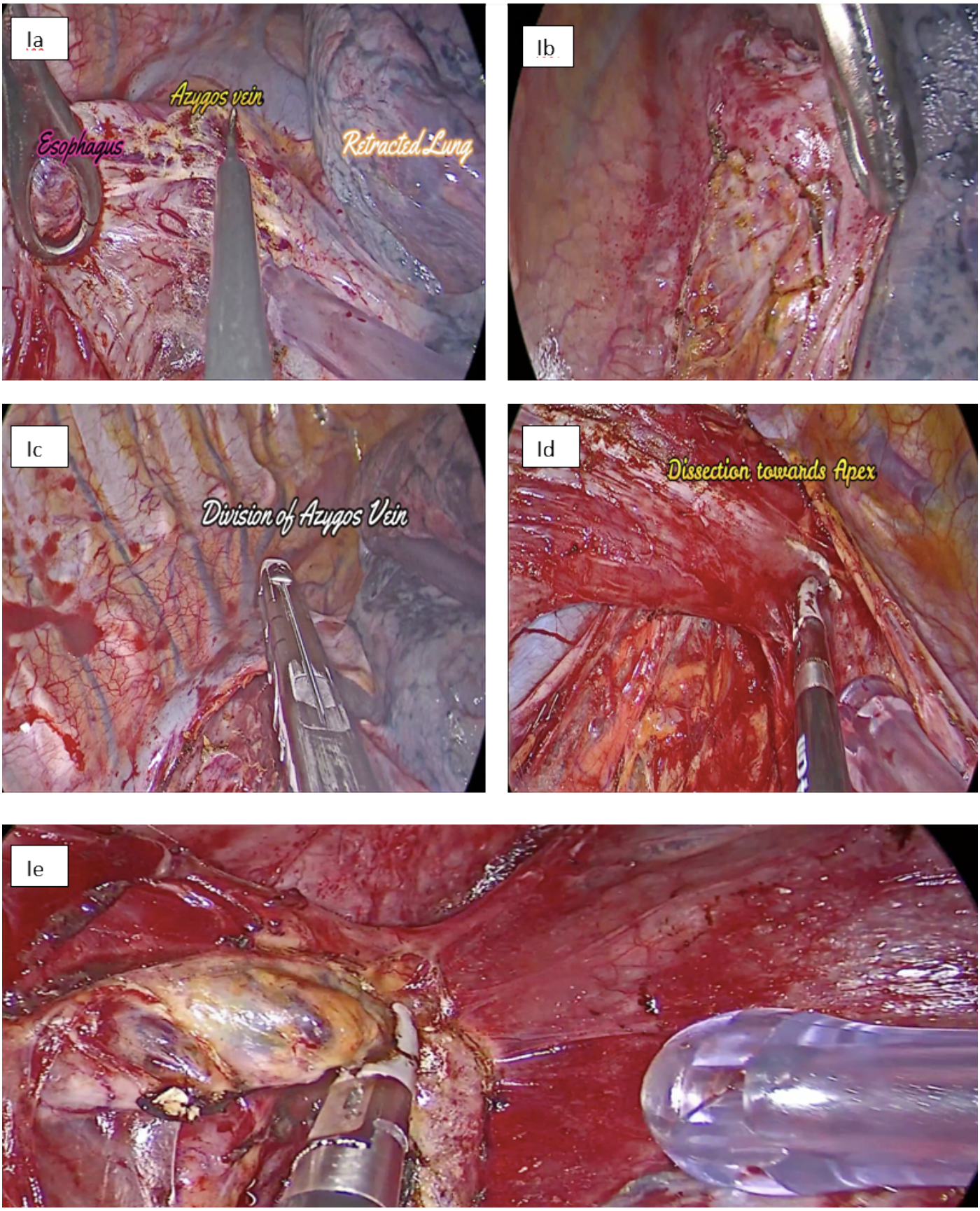
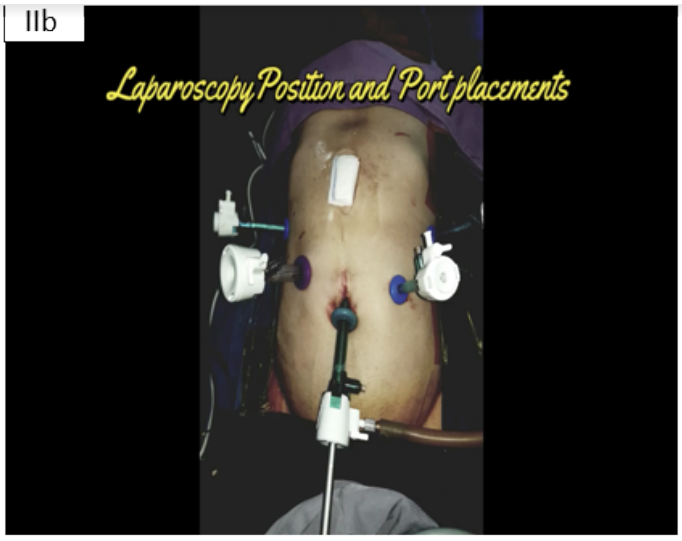
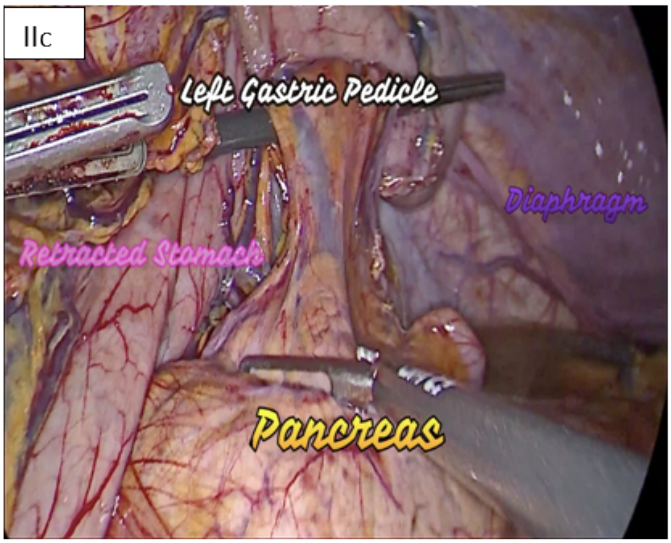
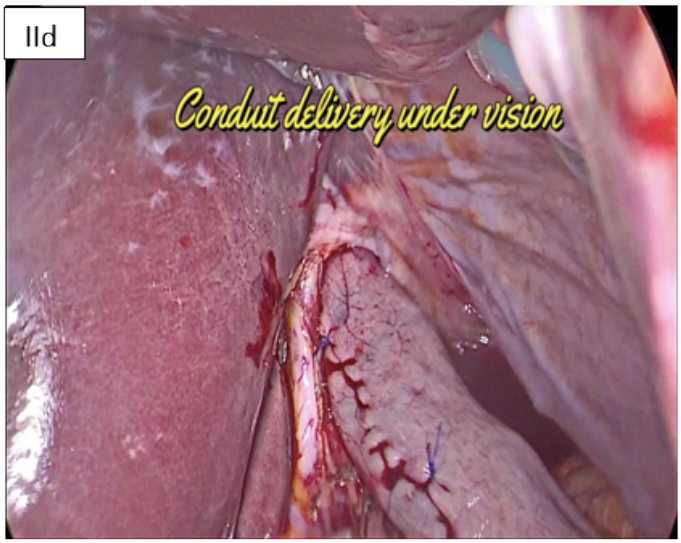



Figure Ia: Medial dissection of thoracic esophagus. Ib: Lateral dissection of thoracic esophagus. Ic: Division of Azygos Vein Id: Dissection towards the root of the neck. Ie: Lymphadenectomy during thoracic part.

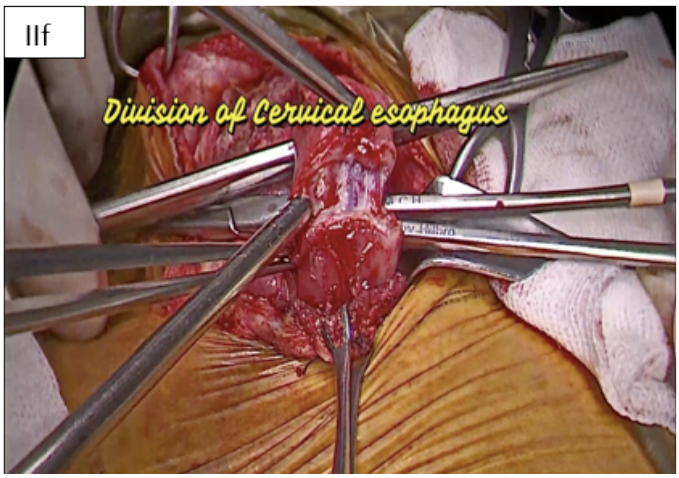

IIa
Laparoscopy Position and Port placements


IIb
Laparoscopy Position and Port placements


IIc
Left Gastric Pedicle
Diaphragm
Retracted Stomach
Pancreas


IId
Conduit delivery under vision


IIe


IIf
Division of Cervical esophagus

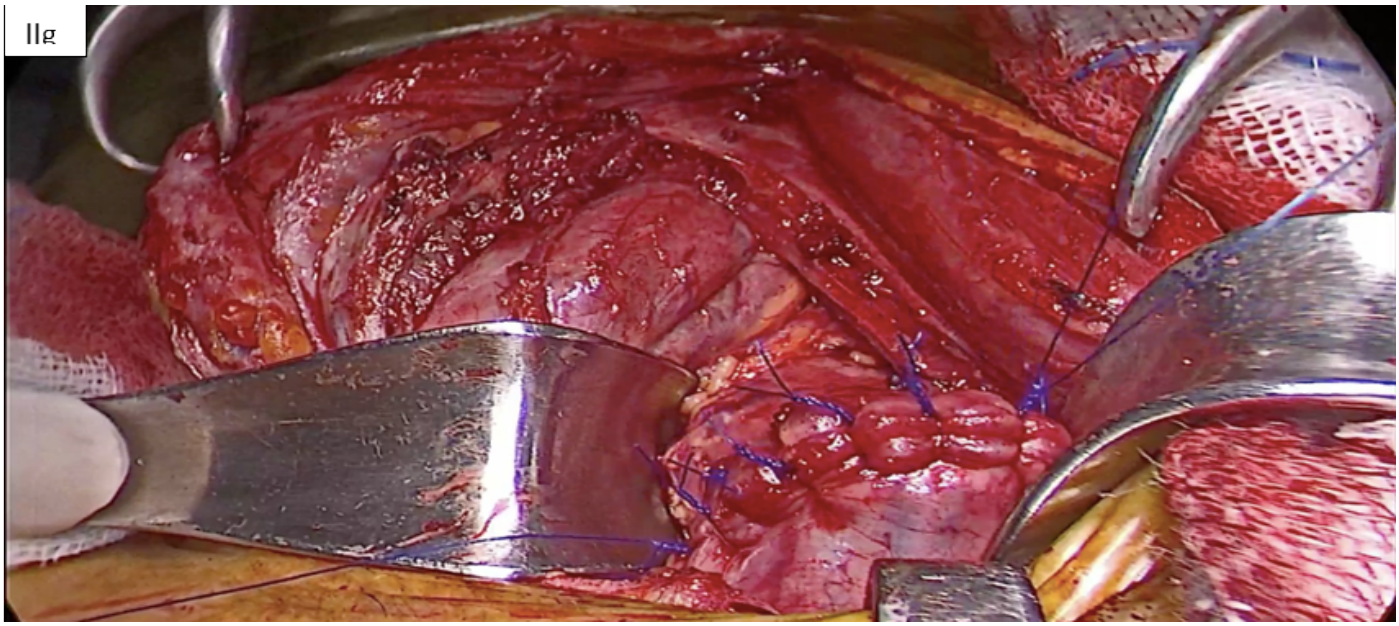



Figure IIa: Laparoscopy position. IIb: Laparoscopic ports position. IIc: Isolation and ligation of left gastric pedicle. IId: Delivery of gastric conduit under vision. IIe: Neck incision. IIf: Division of cervical esophagus. IIg: Single layer interrupted anastomosis in neck.


Figure III: Mobilization to high chair day 1.

anterior border of sternocleidomastoid. Middle thyroid vein was clipped to avoid traction injury near its communication with internal jugular. Strap muscles were divided and thyroid retracted medially. Esophagus was exposed and delivered in wound. It was transected after stay sutures were taken and transection was done such that the mucosa was around 1 cm below the adventitia for adequate anastomosis (Figure IIf). The distal transected end was tagged to a soft nasogastric tube. The abdominal team had opened the abdomen via a small upper midline incision just enough to accommodate small Alexis wound retractor. The specimen was delivered with ease in the abdominal wound as it was fully mobilized. Gastric conduit was created by resecting gastroesophageal junction, cardia, part of fundus and part of lesser curvature with green Echelon reloads. Staple lines were re enforced with monofilament sutures. We routinely do not perform kockerization of the duodenum. Mechanical pyloromyotomy was done and the gastric conduit was tagged to the previously passed soft nasogastric tube from neck. Gastric conduit was delivered in neck under laparoscopic assistance to prevent any twists (Figure IId). At this point it is paramount that the vascular supply of the conduit shall not be under tension.

In neck a single layer end to side anastomosis was fashioned with PDS 4/0 in interrupted fashion (Figure IIg).

Nasogastric and nasojejunal tubes were passed. Nasojejunal tube was manipulated post duodenojejunal junction. Abdominal and neck drains were placed.

Wounds of neck and abdomen were closed.

Operating time: 300 minutes.

Blood loss: 50 ml.

**Post-operative management timeline**

Day 0: Post-operative Anesthesia care unit (PACU), short stay followed by transfer to High dependency unit (HDU). Overnight observation was done.

Day 1: Mobilization to high chair (Figure III), Nasogastric tube, abdominal and neck drain out. Optimal pain control and start of water via NJ tube.

Day 2: Initiation of diet by NJ tube.

Day 3: Epidural catheter, Foley's catheter and central lines out. Full strength and feed of isocal via NJ tube.

Day 4: Chest drain suction off (we discontinue suction when the output is <100ml /8 hour shift). Alternate neck clips off.

Day 5: Chest drain off. Neck clips off, Observed for few hours post chest tube removal. Chest X-ray. Nutritional consult and discharged on NJ feed.

**Tips, Tricks and Pitfalls**

a) Proper positioning of patient for VATS, improper positioning leads to difficult in operation.

b) Early assessment of the tumor before embarking on mobilization, only to find after mobilization that the initial tumor was not resectable!

c) Avoiding injury to pericardium during medial dissection of esophagus.

d) Avoid injury to carina during lymphadenectomy.

e) Avoiding lateral injury of aorta.

f) Staying close to esophagus above the azygos vein to prevent injury of the membranous trachea.

g) Avoiding injury of opposite pleura.

h) During abdominal dissection at all times see the Right Gastroepiploic pedicle, sole option for making gastric conduit.

i) Transfer of gastric conduit under vision to neck as to avoid twisting.

j) Meticulous anastomotic technique.

k) In the post-operative phase keep a close eye on vitals and biochemical markers.

l) Early CT scan to detect leaks in case of suspicion.

m) Early intervention, most of the times only draining abscess in neck and drain placement is sufficient.

n) Early post-operative diaphragmatic hernia is a possibility!

## Comments

Minimally invasive three stage esophagectomy is a safe procedure with minimal morbidity and equal oncological outcomes if it is being carried out in high volume centers that are dedicated to esophageal surgery. Team approach is of paramount importance in these complex procedures. Since the introduction of this technique at our institution we have done 600 minimally invasive three stage esophagectomies. We have developed our own enhanced recovery program. The detailed paper on our institutional experience is in writing.

## Role of team members

AJ: Fellow in Surgical Oncology

JM: Fellow in Surgical Oncology

IUH: Fellow in surgical Oncology

AWA: Senior Instructor in Surgical Oncology

OS: Resident General Surgery

TZ: Resident General Surgery

AAS: Consultant Oncological Surgeon

SHK: Consultant Surgeon

ARK: Consultant Cardiothoracic Surgeon

AI: Consultant Anesthetist

## Disclosures

The author and co-authors declare no conflict of interest.

## Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-chief of this journal.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