Original Research Article

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Minimally invasive esophagectomy for carcinoma esophagus- outcome of surgical management: a single centre experience

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ABSTRACT

Background: Minimally invasive esophagectomy (MIE) has shown an increasing trend, especially in the last decade, in the management of esophageal malignancy. The aim of the present study was to present a cohort of patients who underwent MIE between June 2008 to June 2016 at a single tertiary care centre.

Methods: A total of 103 esophagectomies were performed for esophageal malignancy which included 69 patients by minimally invasive technique. The procedure was performed by thoracoscopic mobilization of esophagus initially followed by reconstruction part done by either by minilaparotomy or by laparoscopic approach i.e. total thoracolaparoscopic esophagectomy (TLE).

Results: The MIE was successfully completed in 65 (94.2%) patients. Operative time ranged from 275 to 420 min (average 356 min). The number of dissected lymph nodes were 5–15 (9 on average). The postoperative period was uneventful - without any complications in 36 (52.17%) patients. The most common postoperative complications were respiratory complications which were observed in 22 (31.88%) patients. Other complications included post-operative bowel obstruction (1 patient), anastomotic leak (4 patients), and necrosis of the gastroplasty (1 patient). One patient had chyle leak while cardiac complication was seen in three cases. The overall morbidity of patients underwent MIE was 47.8%. Thirty-day mortality was 5.79%.

Conclusions: Esophagectomy performed by minimally invasive technique is a widely accepted surgical procedure for patients with middle and lower esophageal malignancy. The biggest benefit of MIE is avoidance of thoracotomy / laparotomy associated pain with resultant decrease in morbidity. The success of MIE requires a dedicated surgical team well trained in both MIE as well as in open surgical procedure.

Keywords: Carcinoma esophagus surgery, Minimally invasive esophagectomy, Thoracoscopic mobilization, Total thoracolaparoscopic esophagectomy

INTRODUCTION

Esophageal malignancy is a highly lethal disease of the gastrointestinal tract and is ranked as the eighth most common cancer worldwide. The incidence of adenocarcinoma of esophagus is showing a rising trend, whereas that of squamous-cell carcinoma remains unchanged. The best curative option for esophageal malignancy is radical surgical resection esophagectomy.

However, it is a tumor with poor prognosis. The 5-year survival even after surgical treatment still remains approximately 15% and rarely exceeds 40%.^{3,4} There is relatively high morbidity and mortality after operation, ranging from 17.9% to 58% and about 6% respectively.^{5,6} In recent years, minimally invasive techniques are coming up in a big way and this is possible due to improvement in immediate surgical results noticed after these surgeries. The present study is the first study in

Indian Armed Forces Health services that shows the challenges of Minimally Invasive Esophagectomy (MIE). The present paper reports on the results of MIE for esophageal malignancy.

METHODS

In the years from June 2008 to June 2016, 103 esophagectomies for carcinoma esophagus were performed at our centre. The minimally invasive surgical technique was preferred, and this procedure was attempted in 69 patients and successfully completed in 65 (94.2%) patients. 31 patients were having tumor located in lower third and 38 were having tumor in middle third of esophagus. Thoracoscopic mobilization of esophagus followed by minilaparotomy was attempted in 48 (69.5%) patients, while in 21(30.4%) patients a totally thoracolaparoscopic approach was adopted. Classical open surgery was adopted in 34 patients in view of bulky esophageal tumors, where in esophageal mobilization was performed by a right posterolateral thoracotomy.

In our set of patients who underwent MIE, there were 57 (82.6%) males and 12 (17.3%) females. The age groups of patients are depicted in Figure 1.

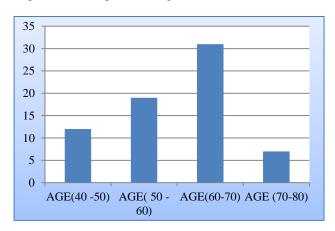


Figure 1: Distribution of patients according to age groups.

Histologically, 41 (59.4%) patients were found to have squamous cell carcinoma and 28 (40.5%) patients had adenocarcinoma. Patients with stage T2/T3, N0/N1 without systemic spread, neoadjuvant chemoradio therapy was offered, which was completed in 64 (92%) patients. Neoadjuvant therapy till 2012 consisted of concomitant radiotherapy and chemotherapy combination of 5-fluorouracil and cisplatin. After that, as per CROSS trial, weekly administration of carboplatin and paclitaxel for 5 weeks and concurrent radiotherapy (41.4 Gy in 23 fractions,5 days per week) was given. In MIE, first surgical step was right sided thoracoscopic mobilization of esophagus in a prone position. Endotracheal intubation with double lumen tube was used in all cases. Two 10 mm ports and two 5mm ports were used. The camera port was located at the angle of scapula at the 5th intercostal space, the working ports were placed

in the posterior axillary line in 2nd and 7th intercostals space, and the last port was put in the scapular line in the 3rd intercostal space for lung traction. We used the 30-degree scope and a retractor for the collapsed lung. The harmonic scalpel was used in right hand and a dissector in left. After dissection of the mediastinal pleura, the thoracic esophagus was mobilized, and the azygos vein was identified and ligated with suture and additional clips and divided as shown in Figure 2 A, B.

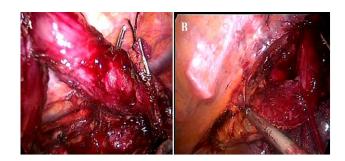


Figure 2: A) Transthoracic thoracoscopic esophagectomy, azygos vein ligated with suture and clip, B) Esophagus taped in the thoracic cavity.

Further dissection was continued carefully and esophagus along with the tumor was dissected off from bronchus and descending aorta till esophageal hiatus. Here while doing thoracoscopic dissection, thoracic duct is carefully identified and safeguarded. Once the thoracoscopic esophageal resection was completed, single intercostal chest drain was positioned in the right thoracic cavity. The patient was then reposition in the supine position for the reconstruction. For abdominal dissection, in the initial part of study in 48 (69.5%) patients, minilaparotomy was done. A stomach tube with preserved blood supply via the right gastroepiploic and right gastric artery was used for the formation of gastric tube. The cervical esophagogastric anastomosis was constructed with a 35mm vascular stapler for posterior wall and interrupted suture for anterior wall. In the later part of the study, in 21 (30.4%) patients, the abdominal dissection was achieved by laparoscopy, there by performing a Thoracolaparoscopic esophagectomy (TLE) which included formation of stomach tube and feeding jejunostomy all done laparoscopically. Surgery was performed in french position with surgeon standing in between the legs using 5 ports - two 10 mm ports and three 5 mm ports. A 30degree scope was introduced through a 10mm port positioned just above the umbilicus. The surgeon used a 10mm port located on the left midclavicular line for harmonic scalpel. His left hand worked with a 5mm port located in right midclavicular line near the rightsubcostal margin. Another 5mm port was placed below the xiphoid process for the liver retraction. The final 5 mm port was placed under the left subcostal margin in the anterior axillary line for retraction. After dissection of the lesser omentum with harmonic scalpel from right to left, careful dissection of esophagus near the hiatus was carried out. Gastrocolic omentum was divided by preserving the gastroepiploic arcade. Linear endoscopic staplers were fired along lesser curvature of stomach for the formation of stomach tube. After completion of minimally invasive resection phase, left-sided cervical incision was given, the esophagus was divided in the deep cervical space and specimen was removed.

The anastomosis of the tabularised stomach to the cervical esophagus was constructed in the same manner

as described above. In one case in which gastric tube necrosis occurred after surgery, the gastric tube was resected and a cervical esophagostomy was performed. Nutrition of the patient was ensured by a feeding jejunostomy. Subsequently after 4 months that patient underwent an esophago-coloplasty using left colon with blood supply based on left colic artery (Figure 3 A, B, C).



Figure 3: A) Gastric tube Necrosis, B) Formation of colonic conduit, C) Measuring the length of colonic conduit.

RESULTS

The MIE was effectively completed in 94.2% patients (Table 1). The operative time ranged from 275 to 420 min; the average time was 356 min, and the thoracoscopic phase was initially 180 min which gradually reduced to 120 min. The laparoscopic phase used to be 210 min in the initial part of study which reduced to 150 min on an average by 2016. Perioperative blood loss never exceeded 450 ml, the average blood replacement volume was 350 ml.

Table 1: Results of MIE.

Variable	Thoracoscopic mobilization + minilaparotomy	TLE
Total	48	21
Neoadjuvant Therapy	44	20
Number of patients without complications	23	13
Average number of lymphnode dissected	9	9
Complete response to Neoadjuvant therapy (CR)	5	4

The number of lymph nodes dissected ranged from 5 to 15, 09 nodes on average. In total of 69 patients taken up for MIE, 04 (5.79%) were converted to open procedure due to suspicion of tumor being stuck to left main bronchus or due to suspicion of injury to the left main

bronchus during tumor dissection, but after doing thoracotomy there was no bronchial injury noted. Postoperatively, 36 (52.17%) patients were without any complications.

As an institutional protocol, we do not perform any contrast study before starting oral nutrition as barium swallow is often falsely negative as reported in Orringer's series which detected 45% leak even after negative swallow examination on 7th postoperative day. On the 7th postoperative day we start oral nutrition if there is no clinical suspicion of leak.

Leak of the cervical esophagogastric anastomosis was seen in 4 patients. In patients having good general clinical condition with minimal leak, only cervical wound was opened and managed conservatively. One patient had bile coming out of chest tube on 4thpost-operative day with features of septic shock and he was found to have gastric tube necrosis. He was managed as mentioned earlier in 'Results' section. So, in our study none of the cervical anastomosis leak patient died. Postoperatively, complications were seen in 33 (47.82%) patients. Respiratory complications in the form of post-operative pneumonia were seen in 22 (31.88%) patients. Respiratory complications were effectively managed conservatively in 20 cases. Two patients developed acute respiratory distress syndrome and subsequently expired. One patient of TLE group developed gastro-tracheal fistula (Fistula with the gastric tube) on 6th postoperative day which was successfully managed with Y stent placed in the bronchus.

Table 2: MIE for esophageal malignancy – number of procedures and complications.

Variable	Thoracoscopic mobilization + minilaparotomy	TLE
Total	48	21
Conversions	4	00
Respiratory Complications	17	05
Cardiac Complications	02	01
Anastomosis Dehiscence	03	01
Conduit Necrosis	01	00
Chylothorax	01	00
Bowel Obstruction	01	00
Gastro- tracheal fistula	00	01
Mortality	03	01

One patient developed acute intestinal obstruction on post-operative day 7 for which re-exploration was done and was found to have an omental band causing intestinal obstruction. The patient died subsequently due to sepsis. Total of three patients had post-operative PSVT which was successfully managed with the help of cardiologist, one of three patients even required cardioversion, but all three had uneventful recovery thereafter. One patient developed chyle leak which was managed conservatively with TPN and Medium chain triglycerides (MCT), but

patient died on 10th post-operative day due to severe sepsis. None of our patient had post-operative bleed or infective complication which required reintervention or reexploration. The overall morbidity and thirty-day mortality of the patients operated by minimally invasively was 47.8% and 5.79% respectively as summarized in Table 2. Based on TNM classification (AJCC-2010) definitive histopathological examination of the removed specimen revealed the following stage: stageI – 2 patients, stage IIA – 21 patients, stage IIB -25 patients, stage III – 16 patients, stage IV – 5 patients as shown in Figure 4.

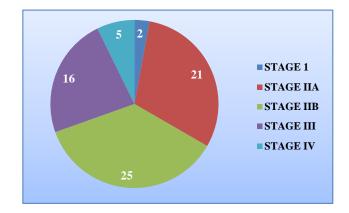


Figure 4: Number of patients as per stage of disease.

A complete response to neoadjuvant treatment with no histopathological tumor findings in the removed specimen was seen in 09 patients. The result of our study and various other studies of MIE is shown in Table 3.

Table 3: Results MIE for esophageal malignancy- Comparison of outcomes.

Authors	MIE	Respiratory Complications (%)	Anastomosis Dehiscence (%)	Morbidity (%)	Mortality (%)
Aujesky, et al	79	17. 7	10.1	31.6	10.1
Decker et al	1932	22	8.8	46	2.9
Luketichet al	222	1.3	11.7	32	1.4
Present Study	69	31.8	5.7	47.8	5.7

DISCUSSION

Minimally invasive procedures are gradually becoming popular and are being used in various surgical procedures in the treatment of both benign and malignant diseases of colorectal, stomach and hepatobiliary systems. Minimally invasive surgery is also finding a place in esophageal carcinoma.⁴ Thoracoscopic mobilization of esophagus was first described by Cuschieri in 1992.⁸ The present literature describes MIE in various modifications like thoracoscopic mobilization of esophagus combined with minilaparotomy; laparoscopy combined with right posterolateral thoracotomy or minithoracotomy or VATS,

or thoracoscopic mobilization of esophagus combined with laparoscopic formation of gastric tube. In most of the tertiary care centres, a hybrid procedure is performed, which involves a combination of a minimally invasive surgery combined with an open procedure; rarely is MIE being performed completely by minimally invasive technique. 10,11

Thoracoscopic mobilization of esophagus and esophagectomy is advisable in patients with tumors located in the middle and distal esophagus. ¹² At our hospital, which is a tertiary care centre and has a long experience in the surgical treatment of esophageal

malignancy, a hybrid procedure was performed in the initial part of study and subsequently it was changed to TLE

Most authors consider the main advantage of MIE is better visualization of the operative field with lessening of injury to adjacent structures, minimization of blood loss and from an oncological point of view, near perfect lymphadenectomy in the mediastinum. 13,14,15 Fabian also reported 50% reduction in blood loss during MIE compared to a classical open operation. 16 Decker reviewed 29 studies regarding MIE and showed removal of 5 – 62 nodes with a median of 14 lymph nodes. 11 We also prefer to perform the surgery from a right-sided approach but by adopting a prone position during thoracoscopy we have noted additional advantage of collapsed lung falling down obviating the need of lung retraction. MIE also has the added advantage of avoidance of postoperative pain of thoracotomy and thereby decreased respiratory complications.

In the literature, conversions of minimally invasive procedure are described as ranging from 3% to 18%. ¹⁰ The common reasons for conversion are bleeding, pleural adhesions after past pneumonias or not maintaining saturation because of prone position and poor lung compliance. ¹⁷ In our set of patients, we converted only 4 (5.7%) patients and the most common reason for conversion was fall in oxygen saturation or suspicion of bronchial injury. The main disadvantage of this approach is the absence of tactile perception in case of large tumors, where there is a real danger of injury to the bronchus.

Leading complications, which have the greatest impact on patient mortality following esophagectomy are respiratory complications, which range from 19 to 44% in different series. ^{18,19}

However, there is no consensus regarding the incidence when comparing thoracoscopic and open procedures. Some authors describe a lower incidence of respiratory complications following MIE, however other authors mention the same incidence compared to classical open procedures. 11,15 In our group of patients, the most frequent complication after MIE was also respiratory complications which occurred in 22 (31.88%) patients which is comparable with world literature. 11 The reported rate of anastomotic dehiscence ranges from 2% to 14%. 18,20 It is more commonly seen in cervical anastomosis than thoracic anastomosis, however, thoracic anastomosis dehiscence has a mortality of up to 60% with development of mediastinitis and septic shock.²¹ Among the most severe postoperative complications following esophagectomy is necrosis of the conduit, commonly as a result of ischemia. It is more often observed in colonic transposition (13.3%) while in cases where a gastric conduit is used, necrosis is reported in 0.5% of patients. 22,23 Whooley described necrosis of the gastric conduit in 0.8% of cases in a series of 710 patients.²⁴ In

our series of 69 patients, cervical anastomosis dehiscence occurred in 5 (7.2%) patients which included one patient of gastric tube necrosis, but all were successfully managed without any mortality.

Chylothorax is a rare but potentially distressing complication after esophagectomy. In meta-analyses by Rindani et al and Hulscher et al, found an incidence of 2% following Trans hiatus esophagectomy (THE) and in 3% patients having an Ivor Lewis esophagectomy and 10% after TTE(Transthoracic esophagectomy). ^{25,26} In present study we had one patient who developed chylothorax in minilaparotomy group who died subsequently because of sepsis. These patients are at danger of developing infectious complications, including abscess formation in the abdominal cavity, pleural effusion, or even empyema which usually requires USG or CT guided drainage.

CONCLUSION

Over the years, MIE has been accepted as a valid surgical treatment option for patients with middle and lower esophageal malignancy. The prime benefits of this technique are wonderful visualization of the operating field, proper lymph node clearance and reduction of bloodloss during surgery. Post operatively the biggest advantage seems to be great reduction in thoracotomy and laparotomy associated pain which in turn decreases morbidity related to respiratory complications. To get good operative results, it is paramount that MIE is performed in specialized centres where the operating surgeon is well versed in both thoraco-laparoscopy and open methods.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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