

## Original Research Article

# A study to assess post operative complications of hybrid approach with video assisted thoracoscopic surgery in locally advanced carcinoma oesophagus

Sivasankar Amaravathy, Khamar J. Banu\*, Ponchidambaram Muthu, Somasekar Ramalingam Durairajan, Dinesh Kumar

Department of Surgical Gastroenterology, GMKMCH, Salem, Tamil Nadu, India

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**\*Correspondence:**

Dr. Khamar J. Banu,

E-mail: [khamar.banu@gmail.com](mailto:khamar.banu@gmail.com)

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### ABSTRACT

**Background:** Despite improvement in the overall survival of patients with carcinoma oesophagus, the morbidity caused by therapeutic interventions is high. The thoracic incision contributes the most to the morbidity with higher pulmonary complications. The minimally invasive and hybrid procedures reduce post-operative morbidities and have similar oncological outcomes compared to open procedures.

**Methods:** Forty patients were included in the study for a period of two years. The objective of this study was to assess the feasibility of a hybrid procedure of VATS oesophagectomy, and laparotomy for the creation of conduit and cervical anastomosis. The patient demographics, tumour characteristics, and intra-operative and post-operative outcomes were analysed.

**Results:** The overall post-operative morbidity was seen in 35% of the patients. Pulmonary complications were noted in 22% of the patients. Oesophago-gastric anastomotic leak was seen in two (5%) patients. Mortality was seen in two patients.

**Conclusions:** A minimally invasive approach has been shown to significantly reduce post-operative morbidity. The pulmonary and cardiac complications that are responsible for morbidity and mortality in oesophageal surgeries are significantly lower with minimally invasive and hybrid procedures.

**Keywords:** VATS, Hybrid procedure, Locally advanced, Oesophagectomy

### INTRODUCTION

Oesophageal malignancies are the eight most common malignancies in the world. The overall survival, including all stages of the disease, is 21%, as reported in the SEER database maintained by NCI.<sup>1</sup> The treatment consists of multimodal strategies involving surgery, chemotherapy, radiotherapy, and biological agents.<sup>2</sup> Surgery is an essential part of the treatment. The surgical procedure involves intervention in the thoracic cavity, abdomen and neck with severe morbidity and occasional mortality. The

thoracic incision contributes the most to the morbidity with higher pulmonary complications. Cuischeri et al first reported minimally invasive thoracoscopic Oesophagectomy.<sup>3</sup> The minimally invasive and hybrid procedures reduce post-operative morbidities like pulmonary complications, cardiac complications, chyle leak, RLN palsy and hospital stay with similar oncological outcomes. Following this trend, many studies have demonstrated the VATS procedure's benefits in reducing Oesophagectomy morbidities. This study aimed to assess the feasibility of a hybrid VATS oesophagectomy and

laparotomy procedure to create conduit and cervical anastomosis. The short-term outcomes were analysed.

## METHODS

Forty patients were included in the study. It was a prospective observational study for two years. The study was conducted between June 2021 to May 2023 at Government Mohan Kumaramangalam Hospital, Salem.

### Inclusion and exclusion criteria

Inclusion criteria were: Age between 18-70 years, tumours involving the mid and lower oesophagus, locally advanced carcinoma oesophagus with T3, T4a and/or N+, histologically proven adenocarcinoma or squamous cell carcinoma, no evidence of metastasis, ECOG 0-2, ASA I-II with normal pulmonary and cardiac status. Patients who received neoadjuvant chemoradiotherapy were included in the study. Exclusion criteria were: T1, N0 and T2, N0 growths, metastatic growths, ECOG >2, women with pregnancy, patients with a past history of malignancy, chemotherapy and radiotherapy. All surgeries were performed by well-experienced surgeons in both open and minimally invasive oesophageal surgery.

Microsoft Excel documented patient demographics, tumour characteristics, medical conditions, and operative details. All patients have received pre-operative neoadjuvant chemoradiotherapy according to CROSS trial protocol. The study started after approval from the institute's ethical clearance committee.

### Surgical technique

Patients were anaesthetised with a single lumen endotracheal tube and placed in the left lateral semi-prone position. All patients underwent McKweon Oesophagectomy with two-field lymphadenectomy.<sup>4</sup> The ports were placed in 5<sup>th</sup>, 7<sup>th</sup> and 9<sup>th</sup> right intercostal space. Pneumothorax was created with CO<sub>2</sub> with a pressure of 8 mmHg and a flow rate of 10 l/min. The mediastinal pleura was first mobilised around the azygous vein with ligatures and hem-o-locks. We routinely divided the azygous vein as it aids in lymph node dissection. Circumferential mobilisation of the oesophagus with para-oesophageal lymph nodes was done. We do not routinely dissect the thoracic duct. The subcarinal nodes and right recurrent laryngeal nodes were dissected. The oesophagus mobilised from the thoracic inlet to the diaphragmatic hiatus. Drain placed in right pleural space. The patient was then placed in the supine position. A midline laparotomy was done. Hiatal dissection was done. The abdominal oesophagus and stomach mobilised. Abdominal lymphadenectomy completed and gastric conduit based on right gastroepiploic artery created. Kocherisation is done for adequate mobilisation of the pylorus. Pylorus is dilated with sponge forceps. The left cervical incision is made, and the cervical oesophagus is dissected. The oesophagus was divided, and the specimen was retrieved. The gastric

conduit is passed through the posterior mediastinum to the neck with utmost care. The oesophago-gastric anastomosis was done with a modified Collard technique. Feeding jejunostomy is done in all patients. Postoperatively, patients were encouraged to do early ambulation, incentive spirometry and breathing exercises. All patients received DVT prophylaxis. Patients were started on oral liquids from the fifth post-operative day.

## RESULTS

Forty patients underwent VATS oesophagectomy with gastric conduit replacement. The mean age was 57.4 years. There were 21 male and 19 female patients. Medical comorbidities were seen in 22.5% of the patients. The patient demographics and tumour characteristics are summarised in (Table 1).

**Table 1: Patient demographics and pretreatment details (n=40).**

Parameters	N (%)
<b>Mean age</b>	57.4 years
<b>Gender</b>	
Male	21 (52.5)
Female	19 (47.5)
<b>Comorbidities</b>	
Hypertension	3 (7.5)
Diabetes mellitus	6 (15)
<b>Site of growth</b>	
Mid thoracic oesophagus	18 (45)
Lower thoracic oesophagus	14 (35)
GE junction - Siewert I	8 (20)
<b>Histology</b>	
Squamous cell carcinoma	19 (47.5)
Adenocarcinoma	21 (52.5)
<b>T stage</b>	
T3	28 (70)
T4a	12 (30)
<b>N stage</b>	
N0	3 (7.5)
N +	37 (92.5)
<b>Tumor differentiation</b>	
Well-differentiated	12 (30)
Moderately differentiated	17 (42.5)
Poorly differentiated	11 (27.5)

The most common location of the tumour was the mid-thoracic oesophagus (45%), followed by the lower-thoracic oesophagus and gastroesophageal junction tumours. Adenocarcinoma was seen in 52.5% of the patients, with 42.5% of the time differentiation being moderate. T3 and N+ was the most common tumour stage. The intra-operative outcomes are shown in Table 2. The mean operative time was 245 minutes. The intraoperative blood loss was between 150 to 200 ml. There was an injury to the diaphragm in one patient. One patient had an injury to the inferior pulmonary vein, which needed conversion to open. Thoracic duct injury was noted in one patient,

which was identified and clipped. The overall post-operative morbidity was seen in 35% of the patients (Table 3). Pulmonary complications were noted in 22% of the patients. Oesophagogastric anastomotic leak was seen in two patients. Both patients underwent contrast-enhanced CT scans of the neck and chest. There was no evidence of a mediastinal leak, and they were managed conservatively.

**Table 2: Intra-operative outcomes.**

Parameters	N (%)
<b>Total operative time</b>	245 min
<b>Blood loss</b>	174 ml
<b>Overall Complications- intraoperative</b>	5 (12.5)
<b>Injury to adjacent organs</b>	
Injury to the diaphragm	1 (2.5)
<b>Injury to liver</b>	-
Injury to left pleura	1 (2.5)
injury to the inferior pulmonary vein	1 (2.5)
Injury to the thoracic duct	1 (2.5)
Conversion to open	1 (2.5)

**Table 3: Postoperative parameters studied.**

Parameters	N (%)
<b>Overall complications</b>	14 (35)
<b>Anastomotic leak</b>	2 (5)
<b>Pulmonary complications</b>	7 (17.5)
<b>Arrhythmia</b>	3 (7.5)
<b>Delayed gastric emptying</b>	5 (12.5)
<b>Chylous leakage</b>	1 (2.5)
<b>Recurrent laryngeal nerve palsy</b>	2 (5)
<b>Need for reoperation</b>	1 (2.5)
<b>Post op mortality</b>	2 (5)
<b>Hospital stay</b>	8.8 days
<b>ICU stay</b>	1.3 days
<b>Tumour related</b>	
R0 resection rate	37 (92.5)
Lymph node harvested (mean)	22 nodes
Lymph node-positive (mean)	5.78 nodes
<b>pT stage</b>	
pT2	3 (7.5)
pT3	15(37.5)
pT4	11 (27.5)
<b>pN stage</b>	
pN0	11 (27.5)
pN1	17 (42.5)
pN2	11 (27.5)
pN3	1 (2.5)
<b>Complete pathological response</b>	11 (27.5)

Cardiac complications like arrhythmia were seen in three patients who required anti-arrhythmic drugs in the immediate post-operative period. Delayed gastric emptying (grade A& B) was seen in 12.5% of the patients. Postoperatively, a chyle leak (Grade IIIB) was seen in one patient, and the patient was re-operated with thoracoscopic thoracic duct ligation. Mortality was seen in two patients (5%); one died on post-operative day 10 with a massive

myocardial infarction. The second patient died of bronchopneumonia after being discharged from the hospital on day 28 after surgery.

## DISCUSSION

Oesophageal malignancies are the eight most common malignancies in the world. The organ traverses through three body cavities; hence, the morbidity associated with the multimodal approach and surgery, particularly, is high.<sup>4</sup> No gold standard technique exists for Oesophagectomy; one model does not suit all. The operative technique depends on tumour location, surgeon preference and availability of resources.<sup>6</sup> Oesophageal cancer surgery can be done in open or minimally invasive methods and a combination of both (hybrid procedures). The laparoscopy/ VATS approach can be replaced with a robotic approach. About 50 % of Oesophagectomy is done by a minimally invasive approach.<sup>7</sup> The minimally invasive surgery for the oesophagus can be; Hybrid procedures: Ivor Lewis- thoracotomy + laparoscopy with chest anastomosis, VATS + laparotomy with chest anastomosis and McKeown- VATS + Laparotomy + cervicotomy with neck anastomosis. Thoracotomy + Laparoscopy + cervicotomy with neck anastomosis. Totally minimally invasive: Ivor Lewis - VATS + laparoscopy with chest anastomosis, McKeown - VATS+ Laparoscopy + cervicotomy with neck anastomosis and Orringer - Laparoscopy + cervicotomy with neck anastomosis (we do not recommend). The VATS oesophagectomy was initially described in the supine position, later changed to a lateral, prone and now semi-prone position.<sup>6,8</sup> The advantages of minimally invasive surgery for oesophageal cancer are less morbidity, including pulmonary complications, cardiac complications, less intraoperative blood loss, less pain and lesser hospital and intensive care.

Many advantages of VATS oesophagectomy are due to the magnified visualisation of structures like recurrent laryngeal nerves, thoracic duct, bronchial artery, airways and lymph nodes.<sup>8</sup> Damage to adjacent structures like the liver, diaphragm and left pleura was lower in the VATS group. However, in a study by Fanyu et al diaphragmatic injuries were more in the minimally invasive group.<sup>9</sup> The operative time was significantly higher in the minimally invasive group compared to the open.<sup>10</sup> The average duration in most studies was between 200-300 minutes. In our study, the mean duration was 245 minutes. The conversion to open in our study group was required in one patient for inability to control bleeding from the inferior pulmonary vein. In the study by Luketich et al the thoracoscopy conversion rate was 5.4%.<sup>11</sup> The overall complication rate in one of the most extensive series of patients was 32%.<sup>11</sup> Pulmonary complications are the most important source of morbidity. Throughout all the studies, including meta-analysis, results consistently show significantly lower rates of pulmonary complications, including atelectasis, pneumonia, and pleural effusion.<sup>11-14</sup> Pulmonary complications were seen in 17.5% of our

patients. The pulmonary morbidity was lower even in hybrid procedures (thoracotomy with laparoscopy) than in open procedures.<sup>15</sup> Longer need for chest drainage and increased drain output has been noted in open groups.<sup>16</sup> The underlying pathophysiology may be reduced FRC, reduced compliance, increased ventilatory pressures, and barotrauma, including pneumothorax and atelectasis. Injury to bronchial branches of the vagus, recurrent laryngeal nerve or bronchial arteries may contribute to pulmonary complications.<sup>17</sup>

Cardiac complications are associated with mortality. Cardiac complications in our study were 7.5%. One mortality in our study group was due to myocardial infarction. Cardiac complications are in the range of 5-15%.<sup>11,14</sup> Hypertension and tachycardia (sympathetic stimulation), hypotension (impaired venous return), bradycardia (vagal stimulation) and arrhythmia may be seen.<sup>17</sup> Anastomotic leak is the Achilles heel of oesophageal resections. Two of our patients had an anastomotic leak (5%). Both patients had Grade A leaks and were managed conservatively. In a comparative study comparing open, hybrid and totally minimally invasive Oesophagectomy, the leak rates were 10%, 15% and 27%, respectively.<sup>18</sup> A meta-analysis of 50 studies with reported anastomotic leaks (Minimally invasive 3680 patients vs. Open 3848 patients) showed no increase in the rate of leaks between both groups.<sup>13</sup> Conduit necrosis was not seen in our patients. Necrosis of conduit is a rare event reported in very few studies.<sup>19</sup> Chyle leak has been reported in many studies. The incidence of chyle leak is reported between 3-26% with a mean of 5%.<sup>11,20</sup> We found a chyle leak in 2.5% of our patients. The mechanism for delayed gastric emptying is multifactorial. It was reported in 1.8% in one of the extensive studies.<sup>11</sup> In our study, delayed gastric emptying was seen in five patients. Hospital stay is lower in patients undergoing minimally invasive Oesophagectomy. ICU stay is also lower than open procedures.<sup>11,20</sup> The mean hospital and ICU stays were 8.8 and 1.3 days. Only one patient required reoperation for a chyle leak. In the study done by Xiang et al length of hospital stay, ICU stay and in-hospital mortality were equal in both groups.<sup>21</sup> The overall survival was 55 %, and disease-free survival was 47.5% in the minimally invasive group.<sup>22</sup> These results are comparable to mortality data from open procedures. The R0 resection rate in our series is 92.5 %. R0 resection rates in other studies with minimally invasive Oesophagectomy were 93-95%.<sup>23,24</sup>

The most common T stage in our study was T3 (37.5%), and N was N1 (42.5%). The mean number of lymph nodes studied in our study group is 22, with mean positive nodes seen in 5.78 nodes. NCCN recommends the removal of at least 15 nodes for adequate staging. The complete pathological response was present in 27.5% of patients. The complete pathological response is reported between 28-48%.<sup>23,25</sup> Port site metastasis has not been reported in any series in the era of NACRT.<sup>26</sup> The overall complications in VATS Oesophagectomy are lower, as seen in meta analysis.<sup>14,27</sup> The inflammatory markers like

IL-6, IL-18, and IL-10 were significantly lower on Days 3,5 and 7 following surgery when compared to open Oesophagectomy.<sup>28</sup> These results were also noted in the Oesophagectomy done for benign diseases.<sup>29</sup>

### Limitations

The limitations of this study include; It is an observational study with few patients. The study period was short, as well as the duration of follow-up.

### CONCLUSION

Multimodal therapy has increased disease-free survival and overall survival in patients with carcinoma oesophagus. The surgery forms an integral component of treatment. Morbidity associated with open surgeries can lead to mortality and prolonged hospital and ICU stays. A minimally invasive approach has been shown to reduce post-operative morbidity significantly. The pulmonary and cardiac complications responsible for morbidity and mortality in oesophageal surgeries are substantially lower with minimally invasive and hybrid procedures.

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