



Original Research Article

TRANSHIATAL ESOPHAGECTOMIES - A TWO DECADE EXPERIENCE FROM A HIGH VOLUME CENTRE

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Abstract: Background: Transhiatal esophagectomy (THE) remains a cornerstone for esophageal cancer resection with gastric conduit reconstruction, particularly in high-volume centers. **Methods:** Retrospective-prospective analysis of 805 THEs performed by a single surgeon at a high-volume center (1998-2021; 315 cases 1998-2011, 490 cases 2012-2021), using stomach tube as universal esophageal substitute. **Results:** Major complications comprised respiratory issues (11%), hemorrhage (9%), anastomotic leak (7%), cardiac arrhythmias (6.5%), wound complications (4.5%), and recurrent laryngeal nerve paralysis/chylothorax (4% each). Overall mortality was <4%. Optimized preoperative preparation, aggressive pain control, minimized ICU stay, and early mobilization reduced hospital length and enhanced outcomes. **Conclusion:** This extensive single-surgeon experience affirms THE's efficacy and safety in esophageal carcinoma management, underscoring the benefits of standardized technique and multidisciplinary care in high-acuity patients.

Keywords: Transhiatal esophagectomy, esophageal cancer, gastric conduit, single-surgeon experience, high-volume center

INTRODUCTION

Despite improvements in preoperative evaluation, anesthetic and operative techniques, and postoperative care, esophageal resection and reconstruction remain formidable operations in patients whose nutritional and pulmonary status have been compromised by cancer of esophagus. The necessity for a combined thoracoabdominal

procedure in a debilitated patient and the disastrous results of disruption of an intrathoracic esophageal anastomosis are major contributing factors to the morbidity and mortality rates of esophageal replacement.

We have employed the technique of blunt transhiatal esophagectomy through the diaphragmatic hiatus and this report reviews our experience with

esophagectomy and esophageal substitution with gastric tube without thoracotomy.

The efficacy of THE as a palliative procedure, as well as its ability to achieve apparent cure in patients with esophageal carcinoma, is emphasized.

Methods

The study has been conducted in the department of Cardiovascular and Thoracic Surgery, Sher-i-Kashmir Institute of Medical Sciences, Srinagar, and Kashmir. It was both retrospective including patients operated from year 1998 to 2011 as well as prospective study including patients operated from 2012 to 2021 by the same surgeon. The eligible patients had histologically confirmed carcinoma of the middle and distal esophagus or carcinoma of the gastroesophageal junction involving the distal esophagus, had no evidence of distant metastases, and did not have unresectable local disease. Retrospective data was collected from the Medical

Records Department of our tertiary care hospital.

Exclusion criteria were previous or coexisting cancer, previous gastric or esophageal surgery, recurrent laryngeal nerve palsy, and extension of the tumor into trachea-bronchial tree and other conditions that made it impossible for the surgeon to construct a gastric tube.

The pre-operative diagnostic workup consisted of endoscopy with biopsy and histological examination, ultrasonography of the abdomen, chest radiography, indirect laryngoscopy and bronchoscopy if tumor invasion of the upper airway was suspected. Computed tomography abdomen and chest was performed in all the patients. Operative risk analysis included standard blood examination, electrocardiography, pulmonary function tests and cardiopulmonary exercise tests (in higher risk patients). Surgery was offered to medically fit patients. After obtaining written informed consent, patients were planned for surgery. All patients were operated by one particular consultant surgeon of our department with experience in esophageal surgery.

Operative technique:

After induction of anesthesia nasogastric tube is inserted and stomach is decompressed. An initial laparotomy is performed through a midline incision to confirm tumour resectability and the stomach is assessed immediately for its suitability as an esophageal substitute. The peritoneum overlying the esophageal hiatus is incised and hiatus is opened by dividing the crus of the diaphragm. Finger dissection of lower esophagus is done after opening the hiatus to assess the resectability of the tumour. The greater omentum along the greater curvature of stomach is retracted to the left and a clear space between stomach wall and the omentum is developed. Left gastroepiploic and high short gastric vessels are

identified and ligated well away from stomach wall to avoid ischemic injury. Dissection is then carried inferiorly along the greater curvature of the stomach towards pylorus after ligating major vessels except right gastroepiploic artery which remains the main supply of mobilized stomach. When the entire greater curvature of stomach is freed from its adjacent omentum, adhesions between the stomach and retroperitoneum are carefully divided to ensure complete gastric mobility. Dissection is then started along the lesser curvature of stomach, the left gastric vein is identified, mobilized and ligated with 3-0 silk ties. The adjacent left gastric artery is identified at its origin from celiac axis, is doubly ligated towards celiac artery, clamped and divided reflecting adjacent lymph nodes to the left with the stomach. Utmost care was taken to avoid any trauma to vascular pedicle. After abdominal exploration and gastric mobilization had been performed, proximal portion of stomach is resected and 3-4 cm wide gastric conduit is fashioned in two layers, inner layer closed with continuous silk 3-0 sutures, and outer layer with continuous Polypropylene 4-0 sutures. The line of resection can be modified as per the extent of growth. In case of mid-thoracic esophageal growth minimum of stomach is sacrificed, however when growth is situated in distal esophagus and gastroesophageal junction, upper partial gastrectomy is mandatory with at least 6-10 cms distance from the tumor. Now, the esophageal hiatus is widened further and retractors are positioned to facilitate exposure of the intrathoracic esophagus upto the level of the carina. This enables enbloc resection of the esophagus and para-esophageal tissue including the crura and pleura (if indicated) under direct vision. Standard lymph node dissection involves removal of lymph nodes in the lower mediastinum, around the esophagogastric junction and along the lesser curvature of the stomach. A radical lymph node dissection is performed at the origins of the left gastric and common hepatic arteries; lymph nodes at the celiac axis were included when enlarged and resectable. As the esophagus was progressively mobilized from lower mediastinum attention is paid to the pleura on both sides. Invariably because of pleura being very thin, it gets breached and hence bilateral chest drains are warranted. During its mobilization the esophagus is grasped and "rocked" from side to side to verify that it is not fixed to adjacent spine, prevertebral fascia, or aorta. In this fashion mobilization of distal esophagus is achieved up to level of carina. Both main bronchi can be safeguarded by feeling their texture with the finger and thereby avoiding any bronchial/tracheal tear while dissecting the esophagus in the mediastinum. What actually is important is the patience of the surgeon during the entire procedure, especially once growth or lymph nodes are adherent to vital structures. Azygous vein on right side or aorta on the left side can be torn by

clumsy or inexperienced hands and can cause major blood loss.

Beginning at a point 1.5-2 cm on the gastric side of pylorus and crossing across the pylorus towards duodenum, pyloromyotomy is routinely performed. A feeding jejunostomy is done 15-25cm away from ligament of Treitz in all patients. With gastric mobilization, dissection of esophagus from lower mediastinum, pyloromyotomy and feeding jejunostomy, abdominal part of procedure ends and attention was turned to cervical part of the surgery. During cervical phase of procedure, 5-7cm oblique incision was made parallel to anterior border of sternocleidomastoid muscle on left side and extended 2-3cm superior to cricoid cartilage, dissection was carried deep into tracheoesophageal groove and circumferential mobilization of esophagus is completed and portion of esophagus along with tumour is delivered into neck wound taking care of recurrent laryngeal nerve which was routinely examined. All possible efforts were taken to avoid any damage to it. Fashioned stomach tube was brought through esophageal hiatus into posterior mediastinum after applying two stay sutures on two sides of gastric tube and corresponding sides of lower esophageal end to avoid any subsequent torsion. An end-to-side hand sewn double layer esophagogastric anastomosis is made in the neck using 3-0 silk posteriorly, 3-0 vichry for inner layer by continuous technique. Pedicled omentum from greater curvature of stomach, designed as per the length of the tube, is routinely sutured around the anastomosis using continuous Polypropylene 4-0 sutures around the esophageogastric anastomosis for completion of the anterior layer (2nd layer (outer)). Two anchoring sutures are taken between prevertebral fascia and gastric tube to keep the anastomosis in place. Both pleural cavities are routinely drained by intercostal tubes to avoid any pneumothorax. Soft rubber drain is kept just lateral to the anastomosis but never inside

the mediastinum and incision was closed back in layers. A drain inserted deep inside the mediastinum leads to mediastinal / subcutaneous emphysema. Another rubber drain was inserted near the hiatus and brought through abdominal wall. Abdominal wound was closed in 3 layers at the end of the main procedure. After extubation, patient was transferred to a high dependency ward for monitoring during initial 24-48 hours and then shifted to general ward. Nutrition was maintained by jejenostomy feed. However, many patients required total parenteral nutrition. Dye study was performed on 10th postoperative day to look for any leak and nasogastric tube was removed on 11th postoperative day. Liquid diet was started if dye study was reported normal and patients were discharged on 13th or 14th post operative day depending upon progress on jejenostomy tube for feeding.

Intraoperative and early postoperative complications occurring in the patients undergoing procedure were noted. A complete proforma containing post-operative events occurring in each patient was filled. After discharging the patients, they were asked to follow the outpatient department of our institute. Jejenostomy tube was removed after 3 weeks if there was no indication of delayed leak from cervical anastomosis. The histopathological findings of resected specimen were analysed. Patients were planned for adjuvant therapy if indicated. All patients were followed at intervals of two weeks during first three months, three to four months during the first two years and every six months for three more years. The follow-up data was also obtained by telephone from the patient or his/her family. The patients were followed for any procedure related complication or recurrence during his/her post operative visit. Recurrence of disease was suspected on clinical grounds. However, whenever a relapse was suspected, radiologic, endoscopic and histologic confirmation was sought.

RESULTS

The present study was carried out in the department of Cardiovascular and Thoracic Surgery (CVTS), Sher-i-Kashmir Institute of Medical Sciences, Srinagar, J&K. The study was designed as prospective and retrospective study and included 315 patients operated for carcinoma esophagus, studied retrospectively from November 1998 to December 2011 and 490 prospectively from January 2012 to October 2021. The study revealed following results after analysis.

The mean age of the study population was 55 years with standard deviation of 5 years. 51.94% of the patients were falling in the age group of 51-60 years as shown in Table – 1, Figure – 1.

Table – 1: Age distribution of patients.	
Age Group	N (%)
<40 years	36 (4.50)
41-50 years	55 (6.8)
51-60 years	418 (51.9)
61-70 years	255 (31.7)
>70 years	41 (5.1)
Total	805

Out of 805 patients, 539 were males and 266 were females as given in Table –2.

Table - 2: Sex distribution of patients

Sex	N (%)
Male	539 (66.95)
Female	266 (33.05)

Most of the operated patients were from rural areas (80%) as shown in Table – 3, Figure – 3.

Table – 3: Dwelling status of patients

Dwelling status	N (%)
Rural	644(80)
Urban	161(20)

Dysphagia was the most common presenting complaint, followed by weight loss. Some patients presented with multiple symptoms as given in Table – 4.

Table – 4: Clinical presentation of patients.

Clinical Presentation	N	Percentage
Dysphagia	772	96
Weight loss	344	42.7
Heartburn	104	12.9
Odynophagia	72	9
Regurgitation	88	11
Early satiety	64	8
Backache	24	3
Non specific	161	20

Mid esophagus was most common site of tumor location followed by distal esophagus. There were multiple lesions in some patients as shown in Table – 5, Figure – 5.

Table – 5: Distribution of patients in terms of location of tumor.

Location of Tumor	N (%)
Mid Oesophagus	386 (48)
Distal Oesophagus	287 (35.6)
Gastro-esophageal Junction	112 (13.9)
Multiple lesions	20 (2.5)

Most of operated patients had TNM stage 3 & TNM stage 2 diseases at the time of surgery due to late presentation which is very common in this part of world. (Table 6, Fig 6)

Table 6 - TNM Staging of Operated Patients.

Stage	N (%)
I	88 (11)
II	394 (49)
III	323 (40)

Mean operating time from start of skin incision to closure of wound was 160+/-10 minutes and average blood loss was 500+/-20 ml.

Table - 7: Mean Operating Time and Mean Blood Loss

	Mean ± SD
Operating time (minutes)	160±8
Blood loss (ml)	500±20

Post operative histological study of resected specimen revealed that squamous cell carcinoma was most common tumour followed by adenocarcinoma. (Table - 8)

Table - 8: Tumor Histology

Tumor histology	N (%)
Squamous Cell Carcinoma	92 (59.74)
Adenocarcinoma	53 (34.41)
Anaplastic	9 (5.84)

Neo-adjuvant chemotherapy was used in 120 patients out of 480 patients diagnosed having squamous cell carcinoma. Three cycles of Cisplatin plus 5-Fluorouracil based chemotherapy was used in these patients. Out of 277 patients of adenocarcinoma 93 patients received neo-adjuvant chemotherapy. Three cycles of Epirubicin plus Cisplatin plus 5-Fluorouracil based chemotherapy was used in these patients. These comparisons are shown in Table – 9.

Table - 9: Neo-adjuvant Chemotherapy

Tumor Histology	N (%)
Squamous cell ca	120 (15%)
Adenocarcinoma	93 (11.5%)

All patients were sent for post-operative chemotherapy and/or radiotherapy as dictated by the individualized parameters and oncologists opinion.

Major complications which occurred in our study included respiratory tract complications, anastomotic leaks, recurrent laryngeal nerve palsy, significant hemorrhage, per-operative & postoperative arrhythmias, postoperative strictures, cardiovascular complications & wound infections. (Table - 10, Figure - 8)

Table- 10: Complications.

Complications	N (%)
Respiratory complications	94 (11.7)
Significant hemorrhage	72 (9)
Anastomotic leak	57 (7.1)
Perioperative cardiac arrhythmias (atrial fibrillation, supraventricular tachycardia)	52 (6.5)
Post operative anastomotic strictures	50 (6.5)
Wound infections	36 (4.5)
Recurrent laryngeal nerve palsy	31 (3.9)
Deep vein thrombosis	31 (3.9)
Chylothorax	21 (2.6)
Pulmonary embolism	6 (0.7)
Myocardial infarction	6 (0.7)
Tracheal injury	5 (0.62)

Table - 11: Estimated 3 year Survival

3-year Survival	
Disease free survival	30.27%
Overall survival	40.24%

Table - 12: Estimated 5 year Survival after Transhiatal Esophagectomy

5-year survival	
Disease free survival	20.60%
Overall survival	28.42%

Overall survival was defined as the time interval from the date of operation until the date of death or most recent follow up. Disease free survival was defined as the time interval from the date of operation until the date of disease recurrence or most recent follow up. Survival curves were calculated according to the Kaplan-Meier method.

DISCUSSION

Despite oncological advances, surgical resection is the only treatment that has repeatedly shown to prolong survival in esophageal cancers. Esophagogastric resection can be performed in many ways and all of them pose considerable challenges to both the surgeon and patient. The technical approaches vary in one or more of following: type of incision, extent of resection, conduit for reconstruction and type of anastomosis. The concept of resection of the

esophagus without thoracotomy had been proposed initially in 1913 by the German anatomist, Denk. In 1933, the British surgeon, Turner, carried out the first successful Transhiatal blunt esophagectomy for carcinoma. THE is often advocated as the preferred surgical approach in patients with benign disease or early tumors or those patients with more advanced disease who would not tolerate a thoracotomy. The advantages of THE are:

Avoidance of thoracotomy and therefore less

postoperative respiratory distress, and Cervical esophagogastric anastomosis as the consequences and complications of this anastomotic leak are much less and easy to manage.

This approach has been criticized because of the lack of a formal two field lymphadenectomy, failure to completely resect tumor under direct vision and because of concern regarding inadequate hemostasis in mobilizing the esophagus from the mediastinum "blindly". Over the past 30 years, the technique of THE has been progressively redefined and is regarded as approach of choice in patients requiring esophageal resection and reconstruction for both benign and malignant conditions. The technical refinements in mobilizing and handling stomach, dissecting esophagus transhiatally, preparing gastric conduit, positioning the stomach into posterior mediastinum and constructing esophagogastric anastomosis have definitely improved the surgical outcome of this procedure over a period of time. Most often patients requiring esophageal resection and reconstruction suffer from obstruction which not only has nutritional consequences from impaired caloric intake but is also associated with pulmonary sepsis due to impaired swallowing. Transhiatal esophagectomy has been the favoured operative approach in our institute since 1998 for managing both carcinoma of the esophagus below the level of carina and tumors of gastroesophageal junction. It has also been utilized for benign lower esophageal diseases, high grade dysplasia and oesophageal perforations which can't be repaired primarily.

Oesophageal cancer has been one of the leading cancers prevalent in our area[2]. This study evaluates our experience and outcomes with transhiatal esophagectomy. Between 1998 and 2021, a total of 805 patients, underwent transhiatal esophagectomy for carcinoma esophagus. Dysphagia, as a symptom was present in almost all the patients (96.10%). Significant weight loss was present in less than half number of patients (42.85%). Dysphagia and weight loss were the presenting features in many studies. Both were described as usual symptoms in one study by Orringer [4]. Most of the operated patients were from rural areas (79.87%). More than half patients were between 51 and 60 years of age (51.94%), the next common group being 61 to 70 years of age (31.81%).

Mid oesophagus was most common site involved by tumor (46.75%), followed by distal oesophagus 71 (35.71%). Most of the operated patients had TNM stage III and II disease. The patients having stage I disease were far less than that described in literature because of less health care services available and lack of routine screening for oesophageal carcinoma in our part of the world. Histopathological examination of specimens revealed squamous cell carcinoma in most cases (59.74%) followed by adenocarcinoma

(34.41%). The tumor behavior and long-term prognosis of adenocarcinoma and squamous cell carcinoma are considered to be comparable. Neoadjuvant chemotherapy in selected patients resulted in higher resectability rate and R0-resection[20].

Esophageal reconstruction was done by gastric tube and esophagogastric anastomosis was done in all patients in our study although colon and jejunum have been used as esophageal substitutes in many studies and functional results of various substitutes have been compared for procedure related complications such as dysphagia, regurgitation and diarrhea. In our study patients undergoing colonic or jejunal interposition were excluded.

In our study mean operating time from skin incision to closure of wound was 160+/-20 minutes which is almost same for other studies such as study conducted by Gupta [19] and Goldminc et al [8] in which the average operating time was 3 to 4 hours. In our study, average blood loss was 500±20 ml, which has been decreasing over the years as our experience with THE has increased, much of esophageal mobilization is performed under direct vision through the retracted diaphragmatic hiatus using long right angle clamps applied to para-esophageal tissues which allows more mobilization of the esophagus and hemostasis under direct vision. This amount is much less than the average blood loss of 1350ml reported by Mark B Orringer et al [15] but significantly more than average blood loss of 370 ml as reported by same author in a study conducted in year 2007[1]. This again signifies the fact that as the experience with THE increases, the amount of blood loss significantly decreases and the safety of the procedure increases[6].

The anastomotic leakage in our study was 7.14% which is significantly lower as compared to a study conducted by Jauch et al [9] which reported anastomotic leak of 39%. Another study by Pommier et al [10] showed anastomotic leak of 13% for THE resection. Several technical aspects during the procedure help to minimize the incidence of anastomotic leak. Avoiding vascular trauma is the key to minimizing cervical esophagogastric anastomotic leak. The dictum "pink in abdomen (after complete gastric mobilization) and pink in the neck (after transposing the stomach into the cervical wound) is a current guiding principle. No traction drains, sutures or bags are affixed to the mobilized stomach, which is manually manipulated upward through the hiatus and mediastinum. Use of pedicled omental flap to reinforce the esophagogastric anastomosis has certainly played a vital role in minimizing the leaks. Use of 4-0 prolene sutures for construction of gastric tube and esophagogastric anastomosis has also decreased the leaks in the anastomosis. In our study only one patient required exploration of the cervical

wound and repair of esophago-cutaneous fistula. All other patients had minor leaks and were managed conservatively. A side-to-side stapled cervical esophagogastric anastomosis reduces the incidence of anastomotic leak and subsequent stricture formation. About 9% of patients undergoing THE had significant hemorrhage and needed post op transfusions. This can be explained by the fact that blood loss in THE is mostly hidden. Vocal cord paralysis was seen in 3.9% patients who underwent THE. In literature, high incidence of vocal cord paralysis was mentioned after transhiatal esophagectomy, indicating that the recurrent nerve is mainly at risk during the cervical dissection and the construction of the esophagogastric anastomosis. Tilanus et al [11] also showed more recurrent laryngeal nerve injuries after THE. Incidence of vocal cord palsy in our study was significantly lower than this study and comparable to other studies. One study by Orringer [1] reported incidence of only 2% and another study by Yannopoulos [12] showed incidence of 1.33%. In our study the perioperative cardiac complications like arrhythmias were seen in 6% patients and wound infection occurred in 4.5% of patients. Chylothorax was seen in 2.59 % of patients undergoing THE. The in-hospital mortality was 3.85% which is comparable to other major studies [1]. Out of 31 deaths, 9 patients died of respiratory insufficiency. Other causes included myocardial infarction, pulmonary embolism, haemorrhage, sepsis. 1 patient died of fecal peritonitis as a result of feeding jejunostomy leak. Mortality rates following oesophagectomy for carcinoma oesophagus in literature vary widely (1% to 28%) and decrease with increasing experience [17]. Rindani and coworkers[13], who reviewed the literature from 1986 to 1996 found in hospital mortality rates of 6.3% for transhiatal resections. The in-hospital mortality according to Horstmann O et al [14] was 15% in the transhiatal procedure. The mean postoperative hospital stay was 12 ± 3 days similar to study by Andrew et al [3] and Kothari et al [7]. Ninh et al [18] in their study showed mean post operative hospital stay of 22.3 ± 16.1 days for THE. Around 50 (6.49%) patients developed post operative anastomotic strictures requiring serial endoscopic dilatations. It was much lesser than 36.4% reported by Bruns et al [5].

Disease free and overall survival was calculated by Kaplan Meier curves. The Estimated three-year disease free survival rate was 30.27% whereas three-year overall survival rate was 40.24%. Also estimated five-year disease free survival rate was 20.60% whereas five-year overall survival rate was 28.42%. Rindani[13] and co-workers found approximately the same 5-year survival rates in their review (24%) for THE. A study conducted by Hulscher [16] showed an overall 5-year survival rate of 29%. Some western world studies have shown overall 5-year survival between 40-50% as most of the patients have early

stage disease at the time of surgery whereas most of our study patients had advanced disease at the time of surgery.

CONCLUSION

The authors of this study have established beyond doubt the efficacy and practicality of the transhiatal oesophagectomy. The centre being one of the biggest centres in the northern part of the country has had enough volume of the cases, and has concluded from its vast experience with the procedure that expertise and experience make THE a relatively safe and effective procedure to tackle the menacing cancer of oesophagus.

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