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Review

Laparoscopic transhiatal esophagectomy for esophageal cancer

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Abstract

Background: Traditional esophagectomy may be associated with mortality, considerable morbidity, and lengthy recovery. It is often performed in cancer patients who are typically older, have associated comorbidities, and are often malnourished, all factors that increase surgical risk. Minimally invasive esophagectomy has the potential advantages of being a less traumatic procedure with an easier postoperative recovery and fewer wound and pulmonary complications.

Methods: A retrospective analysis of patients who underwent laparoscopic transhiatal esophagectomy was performed. Assessed parameters included patient demographics and operative data, pathology results, and long-term follow-up of at least 12 months.

Results: Twenty-two patients underwent laparoscopic transhiatal esophagectomy; 19 had esophageal cancer. Two patients were operated on for Barrett esophagus, and 1 patient had achalasia. The majority of patients were men (82%), and the mean age was 59 years (range 15 to 74 years); 1 patient (4.5%) was converted to open surgery. The average operative time was 380 minutes (range 285 to 525 minutes), and the average blood loss was 220 mL; only 3 patients required transfusion. The median hospital stay was 8 days (range 5 to 46 days). Postoperative mortality occurred in 1 patient (4.5%), and postoperative complications developed in 6 patients (27.2%). In the 19 cancer patients, the average number of harvested nodes was 14.3 (range 10 to 19). The average follow-up was 30 months (range 12 to 48 months). The overall survival for cancer patients was 61% (11 of 19), and disease-free survival was 39% (7/19).

Conclusions: Esophagectomy is a major surgery with considerable morbidity and potential mortality. Minimally invasive esophagectomy is a feasible approach that can be safely performed by surgeons with extensive experience in that field. Advantages include less intraoperative blood loss, a smaller incision, and a potentially faster postoperative recovery. In cancer patients, immediate oncologic goals of adequate margins and lymph node dissection can be achieved, and long-term outcome appears to be similar to that found with open approaches. © 2005 Excerpta Medica Inc. All rights reserved.

Keywords: Esophageal cancer; Laparoscopy; Transhiatal esophagectomy

Transhiatal esophagectomy for the treatment of benign and malignant diseases of the esophagus has gained popularity in the last 2 decades [1]. Prospective studies comparing transhiatal with transthoracic esophagectomy for esophageal cancer demonstrated equivalent long-term survival rates [2–4]. Many surgeons prefer the transhiatal method because it avoids thoracotomy and potential associated morbidity [1]. However, esophagectomy in general, including the transhiatal approach, is an extensive procedure. It is frequently performed in cancer patients who are typically older (ie, in their 70s), have associated comorbidities, and are often malnourished [5,6]. Therefore, esophagectomy is associated with some mortality, considerable morbidity, and lengthy recovery.

During the last decade, the introduction of minimally invasive surgical techniques and their widespread dissemination has proven beneficial in patients with a variety of surgical conditions by resulting in an easier and faster postoperative recovery and fewer pulmonary complications. Several reports in the literature have demonstrated the feasibility of various minimally invasive techniques when applied for esophageal resection. These techniques range from total laparoscopic transhiatal esophagectomy to combined laparoscopic and thoracoscopic approaches [7,8].

Minimally invasive esophagectomy has the potential advantages of being a less traumatic procedure with an easier postoperative recovery and fewer wound and pulmonary complications. In addition, good laparoscopic visualization may facilitate mediastinal dissection and decrease the blood loss associated with open transhiatal dissection [9]. The aim

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of this study was to assess our initial experience with laparoscopic transhiatial esophagectomy placing specific emphasis on esophageal cancer patients.

Patients and Methods

A retrospective analysis of all patients who underwent laparoscopic esophagectomy with a minimum of 12 months of follow-up between January 1999 and January 2003 was performed. Data were collected from the patients' medical records and, if necessary, from patient contact for follow-up data. Parameters assessed included patient demographics and operative data, pathology results, and long-term follow-up.

Surgical technique

Patients were prepared as for open surgery and placed in a supine position with the legs apart in flat leg supports and the neck extended and turned to the right; a nasogastric tube and urinary catheter were inserted. The surgeon was positioned between the patient's legs with one assistant on each side. Five trocars were then inserted in a pentagon shape after induction of pneumoperitoneum to 15 mm Hg. After a thorough investigation of the abdominal cavity, dissection of the gastroesophageal junction was performed with mobilization of the gastroesophageal junction and opening of the hiatus to enable evaluation of resectability and gastric involvement for lower esophageal tumors. In patients with higher esophageal tumors, a mediastinal dissection was carried out at this point to evaluate tumor resectability before commencing the abdominal phase of the procedure.

Stomach mobilization was then performed as in open surgery with the blood supply to the stomach based on the right gastric and right gastroepiploic arteries. Dissection was performed using the harmonic scalpel and endoclips (Ethicon Endosurgery, Cincinnati, OH), when needed. All adhesions of the gastric posterior wall to the pancreas were dissected until full mobilization of the stomach was achieved. An extensive Kocher maneuver was performed to ensure optimal gastric mobilization to the thorax.

Dissection of the thoracic esophagus was performed under direct vision with a 0° laparoscope. Division of the posterior esophageal vessels originating from the aorta was performed using the harmonic scalpel and endoclips. The posterior mediastinal dissection was carried out as high as possible, typically above the level of the carina. The anterior and lateral wall dissection was then completed. Mediastinal lymph nodes were dissected en bloc with the esophagus. Finally, the vagal nerves are identified and divided.

At this point, the cervical phase of the procedure included identification of the proximal esophagus through a left cervical incision and esophageal mobilization using combined sharp and blunt dissection to the level of the previously dissected area; a sponge stick may facilitate in the blunt dissection. The transected esophagus was then divided at the cervical part and inverted into the abdominal cavity by a Penrose suture tied to the proximal end. Inversion facilitated the laparoscopic release of the residual esophageal attachments to the thorax. The esophagus was then exteriorized through an enlargement of the upper port incision followed by distal transection at the appropriate level and extracorporeal gastric-stapled tubing. The incision length was not measured; however, it was large enough to accommodate exteriorization of the specimen with the tumor.

To minimize tumor spread and wound metastases, all distal tumors were removed through the abdominal incision to prevent extraction of the tumor through the narrow mediastinum and the small neck incision. In patients with benign upper esophageal tumors, the specimens were removed through the cervical incision, and the gastric tubing was laparoscopically performed. All wounds were protected with sterile drapes when the specimens were exteriorized.

The mobilized stomach was than advanced to the thorax at the level of the cervical incision using an attached leading Penrose suture. A single-layer anastomosis was performed using nonabsorbable interrupted sutures. The upper portion of the stomach was secured to the prevertebral fascia using several sutures to avoid anastomotic tension, and, finally, the distal abdominal stomach was sutured to the hiatus; pyloroplasty was not performed.

Results

Twenty-two patients underwent laparoscopic transhiatal esophagectomy; 19 of these had esophageal cancer. Sixteen patients had adenocarcinoma, and 3 had squamous cell cancer. Two patients were operated for Barrett esophagus with severe dysplasia, and 1 patient had end-stage achalasia and a nonfunctioning esophagus. The majority of patients were men, and the mean age was 59 years (Table 1).

The average number of harvested lymph nodes in the 19 cancer patients was 14.3. Fifteen of the 19 patients (78%) had T1 or T2 tumors, and the majority were pathologic stage I or II (Table 1). One patient (4.5%) was converted to open surgery because of severe adhesions related to a previous Nissen fundoplication. The average operative time was 380 minutes (range 285 to 525 minutes), and the average blood loss was 220 mL; only 3 patients required transfusion.

Intraoperative complications occurred in 5 (22.7%) patients. Three patients had pneumothorax, and 1 had significant bleeding necessitating transfusion of 3 U blood; eventually hemostasis was laparoscopically achieved with no further consequences. The last patient had a tear in the esophagus during dissection, which was intraoperatively repaired, and the specimen was removed en bloc.

Postoperative complications developed in 6 (27.2%) patients. One patient had an anastomotic leak that resolved with conservative treatment; 1 patient developed an intra-abdominal abscess that was percutaneously drained; 2 patients developed atelectasis; and 2 other patients had de-

Table 1
Overall patient demographics and pathology

Mean age in years (range)	59 (15–74)
Gender (M/F)	18/4
Previous abdominal surgery (%)	4 (18)
Comorbidities* (%)	11 (50)
Pathology (%)	
Adenocarcinoma	16 (72)
Squamos cell carcinoma	3 (14)
Benign	3 (14)
Tumor location	
Lower third†	15 (78)
Mid-third	4 (22)
Mean harvested nodes (range)	14.3 (10–19)
Final pathology (%)	
Stage I	8 (42)
Stage II	8 (42)
Stage III	3 (16)

* One of the following: chronic obstructive pulmonary disease, ischemic heart disease, diabetes, or hypertension.

† Including cardia.

layed gastric emptying and a prolonged ileus. Postoperative mortality occurred in 1 (4.5%) 74-year-old patient with obstructive pulmonary disease who was operated on for invasive cancer. He subsequently developed severe postoperative atelectasis and died 1 month later from respiratory and multiorgan failure. The median hospital stay was 8 days (range 5 to 46 days).

At a mean follow-up of 30 months (range 12 to 48 months), all 3 patients operated for benign disease were alive. Out of the 18 cancer patients that were available for follow-up, the overall survival rate was 61% (11 of 18 patients), and the disease-free survival rate was 39% (7 of 18 patients). Three patients (13.6%) developed long-term complications: 1 patient had an anastomotic fistula that was conservatively managed; 1 patient developed stenosis with dysphagia that responded to dilatation; and 1 patient developed permanent hoarseness.

Comments

Traditional open surgical transthoracic and transhiatal esophagectomies are associated with a relatively high morbidity rate of up to 80% and a 5% mortality rate when performed in by experienced surgeons [10,11]. Major complications include pulmonary problems and anastomotic leaks. Other potential problems include intraoperative bleeding, which is more likely to happen with the transhiatal approach because of the blunt mediastinal dissection, infectious complications, and recurrent laryngeal nerve injury [10].

The transhiatal approach for esophagectomy has gained popularity in recent years because it avoids the additional morbidity associated with thoracotomy [1]. Performance of transhiatal esophagectomy using a laparoscopic approach may further minimize surgical trauma by avoiding a formal laparotomy, thus leading to decreased morbidity and accelerated postoperative recovery.

DePaula et al [12] were the first to demonstrate the feasibility of laparoscopic esophagectomy in a series of 12 patients who underwent laparoscopic transhiatal esophagectomy; 2 of these patients had malignant esophageal tumors. They reported only 1 conversion (8.3%) and demonstrated a good postoperative outcome. Since this initial report, several other studies have demonstrated the feasibility of performing esophagectomy using various minimally invasive approaches. Some investigators have reported the use of hand-assisted devices or minilaparotomy combined with laparoscopy or thoracoscopy [13–15], whereas others have described a formal laparoscopic approach with or without thoracoscopy [9,16]. We chose a laparoscopic transhiatal approach because it enables direct visualization of the mediastinum with an accurate dissection of the mediastinal esophagus and minimal bleeding. In addition, no patient repositioning or single-lung ventilation is required when using this approach. Early stage tumors, as was the case in many of our patients, further facilitate the procedure.

In lower esophageal tumors, our preference is to exteriorize the esophagus and stomach through a small abdominal incision to facilitate determination of the distal margin of the tumor and any involvement of the upper stomach; this is particularly important for gastroesophageal junction and cardiac tumors. After exteriorization, tubing of the stomach is very simple.

The average blood loss in open transhiatal esophagectomy ranges from 500 to 1000 mL [17,18], which compares favorably with the <300 mL reported for laparoscopic and thoracoscopic approaches [9,19] and an average of 220 mL in our series. Furthermore, this approach allows a more meticulous and sharp dissection of the mediastinum with a considerable number of dissected lymph nodes, which is particularly important in cancer patients. In our series, the average number of harvested nodes in cancer patients was 14.3, which is comparable with the numbers reported in other series [16,19].

Extraction of the resected specimen should be performed in a controlled manner when undertaken for esophageal cancer. We prefer to remove the specimen through the abdominal rather than the cervical incision because it allows for safe extraction of the esophagus with optional adjustment of the incision length to avoid unnecessary manipulation of the tumor.

In the absence of any prospective randomized trials, it is difficult to gauge the advantages of minimally invasive techniques over the open-esophagectomy approaches. A retrospective comparison of minimally invasive esophagectomy (a combined thoracoscopic and laparoscopic approach) to open transthoracic and transhiatal esophagectomy was reported by Nguyen et al [20], who reported shorter operative times, less blood loss, fewer transfusions,

Table 2
Outcome of minimally invasive esophagectomy

Author	No.	Laparoscopic procedure	Cancer patients (%)	Conversion (%)	Mean Op time (min)	Mean blood loss (mL)	Mortality (%)	Significant complications (%)	Mean hospital stay (d)	Mean no. lymph nodes	Mean follow-up (mo)/overall cancer patient survival rate (%)
DePaula et al [12]	12	Transhiatal esophagectomy	2 (16.6)	1 (8.3)	256	Minimal (no transfusion)	0	Anastomotic leak: 1 (8.3)	7.6	NA	NA
Swanstrom et al [9]	9	Transhiatal esophagectomy	6 (66.6)	0	390	290	0	Permanent dysphonia: 1 Subclavian thrombosis: 1 Stenosis + dilatation: 2	6.4	NA	13/60
Luketich et al [5]	222	Combined thoracoscopic/ laparoscopic esophagectomy	175 (78.8)	16 (7.2)	NA	NA	3 (1.4)	Anastomotic leak: 26 (11.7%) Gastric-tip necrosis: 7 (3.2) Tracheal tear: 2 (0.9) Respiratory disease/ pneumonia: 21 (9/5) Permanent recurrent laryngeal injury: 8 (3.6) Myocardial infarct 4 (1.8) Pulmonary embolism 3 (1.4) Deep vein thrombosis: 3 (1.4)	7	NA	Kaplan-Meier 40-month survival Stage I 70 Stage II 20 Stage III 25
Nguyen et al [19]	46	Combined thoracoscopic/ laparoscopic esophagectomy	38 (82.6)	1 (2.2)	350	279	2 (4.3)	Anastomotic leak: 4 (8.6) Pulmonary embolus: 1 Respiratory failure: 2 (4.3) Permanent dysphonia: 1 Tracheogastric fistula: 1 Anastomotic stricture: 8 (17)	8	10.3	26/68.4
Present study	22	Transhiatal esophagectomy	19 (86)	1 (4.5)	380	220	1 (4.5)	Anastomotic leak: 1 (4.5) Intra-abdominal abscess: 1 Stenosis + dilatation: 1 Permanent dysphonia: 1	8	14.3	30/61

NA = not available.

and shorter intensive care unit and hospital stays with the minimally invasive approach.

Luketich et al [5] recently reported the largest series to date of minimally invasive esophagectomies. These advocates of minimally invasive esophagectomy reported their experience with a combined laparoscopic and thoracoscopic approach in 222 patients operated on during a 6-year period. They reported only a 1.4% mortality rate, but 32% of their patients experienced major complications, whereas 24% experienced minor complications. The leak rate in this series was 11.7%. Generally, the leak rates after minimally invasive esophagectomy are similar to those in the open counterparts and range from 0% to 12% [5,9,12,16,19]. Table 2 lists the outcome of minimally invasive esophagectomy in several reported series.

It is important to emphasize that the postoperative outcome in patients who undergo esophagectomy is affected considerably by the magnitude of the procedure itself and not necessarily to the access approach alone, as reflected by the considerable number of complications with both the open and laparoscopic approaches. As such, a large number of patients are required to confirm any advantage for the laparoscopic approach. Our study is an initial report with a small number of patients that demonstrates the feasibility of this procedure and its advantages of a smaller incision and less intraoperative blood loss compared with data reported from open surgery [17,18]. These advantages did not translate into noticeable clinical improvement in morbidity and recovery in our study. However, these potential advantages may be revealed as experience with the laparoscopic approach is gained. This trend was demonstrated by the significantly fewer pulmonary complications and the shorter hospital stay than in the large series of open surgery reported by Luketich et al [5]. However, any potential advantages during open surgery will need to be confirmed in prospective randomized studies with a large number of patients.

One of the drawbacks of minimally invasive esophagectomy is the longer operative time and the need for extensive surgical experience with these techniques. Luketich et al [16] reported a 7.5-hour median operative time in their series, which decreased to 4.5 hours after the 20th procedure. In our series, the average operative time was 6.3 hours and was also dependent on the size of the tumor.

Although the patients in our series did not have preoperative chemoradiation, considerable data have been published relative to patients undergoing open transhiatal esophagectomy after chemoradiation without alluding to increased difficulty or complications [6]. As such, it appears that neoadjuvant chemoradiation does not preclude a laparoscopic transhiatal approach.

Oncologic resection in cancer patients is feasible with the laparoscopic approach. In our series, the average number of harvested nodes was 14.3, which is comparable with the numbers reported in open transhiatal series [21]. However, the long-term outcome of minimally invasive esophagectomy in these patients is difficult to gauge because the length of follow-up and the number of patients operated using this approach is still limited, and no data are available from prospective randomized trials. In addition, the poor outcome of these patients because of the nature of the disease makes long-term evaluation even more difficult.

However, analysis of stage-specific survival from the large series of Luketich et al [5], represented in Kaplan-Mayer survival curves, demonstrated a comparable long-term outcome to open approaches. In our series, we found 60% overall survival and 39% disease-free survival rates at an average 30-month follow-up, both of which are also equivalent to rates found with the open approaches.

Regardless of the surgical approach, esophagectomy is a major operation with considerable morbidity and possible mortality. In addition, it is commonly performed in esophageal cancer patients with associated poor long-term prognosis. However, minimally invasive esophagectomy is a feasible approach that can be safely performed by surgeons with adequate experience in that field. Advantages include less intraoperative blood loss, a smaller incision, and potentially faster postoperative recovery. Laparoscopic esophagectomy appears to be an oncologically safe approach for cancer patients. Immediate oncologic goals of adequate margins and lymph node dissection can be achieved, and long-term outcome appears to be similar to that of open techniques.

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