Minimally invasive esophagectomy for cancer; beyond techniques

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Chapter 4

Technique and short-term outcome of minimally invasive Ivor Lewis esophageal resection for distal esophageal and gastroesophageal junction cancers.

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ABSTRACT

Introduction

Esophagectomy can be performed by a two-stage procedure with intrathoracic anastomosis, the Ivor Lewis esophagectomy. The increasing incidence of distal carcinomas of the esophagus and the esophagogastric junction induce more interest in this Ivor Lewis esophagetomy. Also minimally invasive procedures are increasingly being implemented in order to reduce postoperative complications. The study reported in this article involved a multicentre analysis of minimally invasive Ivor Lewis esophagectomy for achieving short-term results

Methods

During the period of 2010-2013, 103 patients in five different centers underwent minimally invasive Ivor Lewis esophagectomy for distal resectable esophageal cancer.

Results

Most important complications were pulmonary complications (16%) and anastomotic leakage (15%) with or without thoracic empyema. Anastomotic leakage only occured after using the transoral stapler technique. Mortality rate was 2%.

Discussion

Though Ivor Lewis minimally invasive esophagectomy is increasingly implemented, important problems remain. Questions arise how to standardize the operative technique and most important the type of anastomosis and therefore decreasing the rate of anastomotic leakage. Nonetheless, we recognize the advantage of starting the operation abdominally and keeping a long segment of the patient's own esophagus as worthy reasons for continual improvement.

INTRODUCTION

In 1946, a standardized approach, for esophageal resection for carcinoma of the middle third of the esophagus was introduced by Ivor Lewis.[1] This approach involved a two-stage procedure that included a laparotomy and 1 to 2 weeks later, a thoracotomy with intrathoracic anastomosis. Risks of anastomotic leakage in the thorax with fatal consequences, such as empyema, resulted in the development of the three-stage approach with a cervical anastomosis.[2] In the case of leakage, a cervical fistula remained a manageable complication.[3] Especially in the Western world, contemporary forms of gastric tube reconstruction after esophagectomy are intrathoracic anastomosis as well as cervical anastomosis. There is some evidence that cervical anastomosis could be related to more anastomotic leakage and recurrent nerve lesions, but available randomized evidence is limited.[4] Currently, the increased number of gastresophageal junction tumors in combination with advanced surgical techniques such as the minimally invasive approach, has induced the rebirth of the two-stage procedure, avoiding the necessity for a neck dissection.

Minimally invasive procedures are increasingly being implemented in order to reduce postoperative complications, and— by avoiding the thoracotomy incision—possibly enhancing quality of life. Based on the majority of the series, which includes one randomized trial, we can regard minimally invasive esophagectomy as bringing about a lower rate of postoperative respiratory infections and a better quality of life than would the open procedure.[5-11]

Minimally invasive two-stage Ivor Lewis esophagectomy involves a right thoracoscopy and laparoscopy. The thoracic phase of this procedure can be performed through a lateral right thoracic approach with a right lung block by selective intubation or in prone position without selective lung block. This prone approach, involving partial lung collapse, may result in lower percentage of pulmonary complications.[12,13] The combination of minimally invasive esophagectomy in prone position with an intrathoracic anastomosis could therefore be associated with an improved outcome.

The study reported in this article involved a multicentre analysis of minimally invasive Ivor Lewis esophagectomy for achieving short-term results and had as main goal the description of the indications, the operative techniques and the postoperative outcomes of this procedure. Facets of the study are treated below.

PATIENTS AND METHODS

During the period of 2010-2013, 103 patients in five different centers underwent minimally invasive Ivor Lewis esophagectomy for esophageal cancer. Patients with resectable carcinomas of the distal esophagus or gastro-esophageal junction, Siewert II and III [14] were included to receive minimally invasive esophagectomy with intrathoracic anastomosis. One center in Girona, Spain and four centers in the Netherlands (AMC and Vumc in Amsterdam; Canisius Hospital in Nijmegen) have participated in this retrospective study. A database was conducted with *pre*-operative, *intra*-operative and *post*-operative data of these patients The indices used were: age, gender, type of tumor, location, preoperative assessment, use of neoadjuvant therapy, operative technique (lateral or prone thoracoscopy), the different types of intrathoracic anastomosis, postoperative complications, pathology, hospital and IC stay, and mortality.

Operative technique

The following standards pertain to the operative technique mostly used in this series.

1. Laparoscopy

- Surgeon between the legs.
- Pneumoperitoneum 14 mm Hg.
- Liver retractor according to Nathanson.
- Four other trocars, camera, and three work trocars.
- After inspection, gastro-colic ligament is opened and greater curvature dissected free with adequate preservation of the gastro-epiploic vessels.
- Extensive lymphadenectomy is performed of the celiac trunk, hepatic artery up to the liver hilus and splenic artery. Posterior peritoneum of the lesser sac is taken with the lymph nodes.
- Small gastric conduit is constructed by means of linear endoscopic stapler, leaving a small bridge with the specimen. Some stitches are placed to protect the stapler line.
- Dissection of the esophagus in the hiatus. If tumor is growing in the hiatus, take some ring of the hiatus with the specimen.
- Dissection will continue along the transhiatal planes, the aorta, pericard sac and both pleurae.
- Thoracic drain is placed in the left thoracic cavity and jejunostomy is constructed.
- Closure of the ports and positioned the patient in prone position with abduction of both arms..

2. Thoracoscopy in prone position

- Open thoracoscopy at the point of the scapula. Insufflation with 8 mm Hg.
- Three other trocars are positioned.
- Start dissection along the right lung, after division of the pulmonal ligament
- From the right bronchus open in direction to the azygos vein and there dissected free the vein
- As much as possible dissect the esophagus and periesophageal tissues free from the pericard sac, right bronchus and carina with lymph nodes *en bloc*.
- Open the pleura along the azygos vein up to the hiatus. Hiatus is dissected free.
- Take the thoracic duct with the specimen between the aorta and azygos vein, clip the duct adequately.
- Displacing the specimen to the side of the lung, the meso-esophagus is presented and divided between the aorta and specimen. Vessels from the aorta to the esophagus are divided, including bronchial arteries to the esophagus. Once divided, the pericard sac becomes visible and the left bronchus. Lymphadenectomy is now completed.
- After withdrawal of the nasogastric tube, the esophagus is divided proximal of the carina lymph nodes by means of the endostapler.
- The ORVIL ® system is now introduced through the mouth of the patient by the anaesthesiologist up to the stump of the esophagus and there a small opening is made at one of the edges and the tube is pulled up to see the axe of the anvil.
- A small thoracotomy is performed from the tip of the scapula in anterior direction and is protected by ALEXIS ® system. The right lung is now blocked.

- The specimen is now retrieved, without torsions and the specimen is resected. The tube of the ORVIL is taken out and the gastric tube directed to the esophagus to control the tension of the anastomosis.
- The corresponding 25 mm circular stapler is introduced extracorporeal in the gastric tube and directed to the anvil, fixed and fired. The side loop is divided by means of the linear stapler and the anastomosis controlled (donuts and methylen blue).
- Thorax cavity is drained, trocars removed and ports and thoracotomy closed.

RESULTS

Patient characteristics are presented in Table 1; peri-operative data are depicted in Table 2; and post-operative complications in relation to hospital stay are outlined in Table 3. Table 4 represents the anastomotic leakage related to anastomotic technique.

In this multi-centre series two intra-operative complications were observed: a lesion of the splenic artery occurred during laparoscopy in one patient, leading to laparoscopic splenectomy and a technical failure, caused by a migration of a piece of the balloon of the selective tube into the right bronchus causing ventilation problems. Only after several attempts using bronchoscopy could the small piece be removed. This complication prolonged the operating time. Both complications had no consequences leading to postoperative complications or longer hospital stay.

Regarding other complications, 15 patients experienced an anastomotic leakage (15%). In ten patients of this group, anastomotic leakage was the cause of thoracic empyema necessitating a surgical re-intervention by thoracotomy or re-thoracoscopy. In the other five patients, without empyema, the anastomotic leakage could be was managed by adequate thoracic drainage, endoscopic placement of a stent and the use of intravenous antibiotics. In both circumstances, their hospital stays were prolonged respectively with 53 and 47 days. One patient died after a protracted ICU-admission following anastomotic leakage and empyema treated only by endoscopic stenting and repeatedly thoracic drains. The anastomotic leakage rate is highest in the Orvil group, using a peroral stapler system, as depicted in table 4. No leakage was seen using other techniques.

The other most frequently-seen postoperative complication is pulmonary infection, as recorded in 16% of the patients. Most of the pulmonary infections were treated by intravenous antibiotics and physiotherapy. In one patient percutaneous drainage of a pleural fluid collection was deemed necessary. Another patient developed acute respiratory distress immediately after the operation possibly as a consequence of anaesthetic allergy, being re-intubated in the operating room.

Two patients were re-operated because of postoperative bleeding. One of them had developed an aorto-esophageal fistula and died consequently. The other patient received a right thoracotomy twice, first for postoperative bleeding and a second time for thoracic empyema.

Two patients suffered from cardiovascular complications, treated by digoxin and anticoagulants.

One patient with dilatation of the gastric conduit and delayed passage through the pylorus underwent a right thoracotomy under diagnosis of partial torsion of the conduit. During exploration no torsion was observed but only dilatation due to paralysis. Finally, the patient recovered transit. Another patient underwent a re-thoracoscopic exploration under suspicion of anastomotic leakage because of clinical deterioration. No anastomotic leakage was confirmed, so that the patient finally was treated by thoracic drainage and intravenous antibiotics. Both cases resulted in prolonged hospital stay of respectively 39 and 27 days.

Distal leakage at the staple line was seen in another patient, such being closed by laparotomy, followed by a hospital stay of 56 days.

A broncho-esophageal fistula observed at the third postoperative day was treated by revision of anastomosis and muscle transposition by right thoracotomy. Nevertheless the hospital stay of this patient was only 16 days.

Table 1. Baseline characteristics

	N 103
Gender	
male	89 (86%)
female	14 (14%)
Age	62,6 (± 10,1)
Tumor type	
Adenocarcinoma	63 (62%)
Squamous cell carcinoma	18 (18%)
Adenosquamous cell carcinoma	21 (20%)
Tumor location	36
Neoadjuvant therapy	
None	11 (11%)
Chemoradiotherapy	88 (85%)
Chemotherapy	4 (4%)

Table 2. Peri-operative data

	N 103
Positioning during thoracic phase	
Prone	75 (73%)
Lateral decubitus	28 (27%)
Blood loss (ml)	321 (± 282)
Operative time (min)	318 (± 75)
Pathology	
T0	32 (32%)
T1	18 (18%)
T2	10 (10%)
T3	40 (40%)
T4b	1 (1%)
N0	66 (65%)
N1	23 (23%)
N2	10 (10%)
N3	3 (3%)
Number of lymph nodes	18 (± 8)
Hospital stay (days)	21 (± 24)
ICU stay (days)	6 (± 10)
Mortality	2 (2%)

Table 3. Major complications

Complications	N (103)	Regimen	Hospital stay (days)
Anastomotic leakage	15 (15%)		51(±35)
Empyema	10 (10%)	Thoracotomy	53 (±36)
No empyemea	5 (5%)	Endoscopic stenting	47 (±35)
Pulmonary complications	16 (16%)	Antibiotics, re-intubation	25 (35)
Bleeding	2 (2%)	Thoracotomy	70
Cardiovascular complications	2 (2%)	Medication	10
Suspicion torsion gastric conduit	1 (1%)	Thoracotomy	39
Para-esophageal herniation	1 (1%)	Thoracotomy	13
Suspicion anastomotic leakage	1 (1%)	Re-thoracoscopy	27
Leakage of stapleline stomach	1 (1%)	Laparotomy	56
Broncho-esophageal fistula	1 (1%)	Thoracotomy	16
Iatrogenic lesion of spleen	1 (1%)	Laparoscopic splenectomy	10
Technical failure	1 (1%)	Longer operating time	23

Table 4. Anastomotic leakage for anastomotic type

	N 103	Leakage n (%)
Anastomotic type		
Handsewn	1	0 (0%)
25 mm stapler + handsewn pursestring	2	0 (0%)
Orvil 25 mm		
28 mm single stapling technique with big omental flap	55	15 (15%)
28 mm single stapling technique with small omental flap + dexamethason	18	0 (0%)
	18	0 (0%)

DISCUSSION

In conclusion this multicentre retrospective study describes operative treatment of distal esophageal and G-O junction adenocarcinomas (Siewert II and III) [14], by means of Ivor Lewis MIE, further portraying that this type of surgery is often accompanied by postoperative complications, ranging from minor infections to be treated with antibiotics to anastomotic leakage with associated empyema, requiring re-intervention.
Anastomotic leakage rate was 15% after Ivor Lewis MIE, in the series here presented. Furthermore in 10% of patients anastomotic leakage was accompanied by thoracic empyema, necessitating a Thoracotomy, thereby indicating that the operation yet is not safe enough. This concerns technical problems to be addressed, such as: tension of the gastric conduit, vascularisation of the margins, anastomosis technique, tears of the esophagus in the end-to-side anastomosis, torsion of the gastric conduit, the weight of the gastric tube (hanging), the absence of esophageal peritoneum, contractions etc.[15-20]
Indications for engaging an Ivor Lewis two-stage esophagectomy are changing; there are surgeons using this approach only for tumors type II and III according to Siewert [14] whereas others only consider this type of resection oncological safe if a longitudinal 5 cm resection margin is obtained, making this approach suitable for tumors located 5 cm distal of the carina. An esophageal resection margin is considered safe at about 5 cm. [15-17]
In view of the postoperative outcome of this multicentre Ivor Lewis minimally invasive esophagectomy, it seems that this procedure is still in design phase, with different thoracoscopic approaches and many different anastomosis techniques.[21] The oncological procedure is standardized by a two-fields lymphadenectomy and an adequate circumferential resection margins. Paratracheal lymphadenectomy is performed only by indication. Technical points of discussion pertain the approach, lateral or in prone, the convenience or not to block the right lung, the type of anastomosis, where to place the assistance small thoracotomy and questions about postoperative feeding like jejunostomy or the use of a nasogastric tube.[12, 16]
In the series here presented, different types of thoracoscopic approaches were involved; one group did the thoracoscopy in lateral position and the others in prone position. Concerning the anastomosis used, the question remains which technique is the safest. In the results of this series the use of the Orvil stapler may contribute to anastomotic leakage, but the numbers are not large enough for a proper assessment. Further studies are necessary in order to establish the optimal anastomotic technique.[21]
An important advantage of Ivor Lewis MIE is that its use avoids neck dissection, resulting in less recurrent laryngeal nerve lesions, perhaps even less strictures of anastomosis, as well as better functional results obtained by a longer segment of the patient's own esophagus in situ.[19, 22-23]
In the Western world, distal esophageal and gastro-esophageal junction adenocarcinomas (Siewert II and III) together number the majority of all diagnosed esophageal cancers treated, accounting for almost 80%.[13] For treatment, the two-stage operation prevails as first choice. It entails starting the operation abdominally to follow then in the right thorax with the esophageal resection and intrathoracic anastomosis. Commencing in the abdomen is advantageous; first of all because one can then stage the tumor properly, deciding which operation is indicated. Properly staging between Siewert I and II and III is a matter of uncertainty having important consequences.[14] During the abdominal phase, the surgeon can based on findings decide to perform a total gastrectomy in the type I or to decide to proceed with the esophageal

resection as two-stage procedure.

A different situation still exists in the Eastern world where squamous cell cancers are the majority treated and the three-stage operation is the rule.[24] Moreover, neoadjuvant therapy, chemotherapy alone or chemoradiotherapy are advantageous and significantly increase the survival of patients in both types of cancers.[25] But the conventional operation has still a huge morbidity, especially caused by respiratory infections and leakage of the anastomosis. To reduce the respiratory infection rate and increase the postoperative comfort and quality of life the minimally invasive approach, avoiding the thoracotomy, is increasingly being implemented worldwide.[6,7,16]

We contend that the MIE Ivor Lewis esophagectomy is an approach to stay. While, important problems in its implementation remain, such as answers to question how to standardize the operative technique and the type of anastomosis and how to decrease the leakage up to 0%, nonetheless, we recognize the advantage of starting the operation abdominally and keeping a long segment of the patient's own esophagus as worthy reasons for continual improvement.

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