

Hiatal Hernia After Esophagectomy for Cancer

Hylke J. F. Brenkman, MD,* Kevin Parry, MD,* Fergus Noble, PhD,
Richard van Hillegersberg, MD, PhD, Donna Sharland, Lucas Goense, MD,
Jamie Kelly, BM, BSc (Hons), James P. Byrne, MD, Timothy J. Underwood, MD, PhD,*
and Jelle P. Ruurda, MD, PhD*

Department of Surgery, University Medical Center Utrecht, Utrecht, the Netherlands; and Department of Surgery, University Hospital Southampton, Southampton, United Kingdom

Background. Hiatal hernia (HH) after esophagectomy is becoming more relevant due to improvements in survival. This study evaluated and compared the occurrence and clinical course of HH after open and minimally invasive esophagectomy (MIE).

Methods. The prospectively recorded characteristics of patients treated with esophagectomy for cancer at 2 tertiary referral centers in the United Kingdom and the Netherlands between 2000 and 2014 were reviewed. Computed tomography reports were reviewed to identify HH.

Results. Of 657 patients, MIE was performed in 432 patients (66%) and open esophagectomy in 225 (34%). A computed tomography scan was performed in 488 patients (74%). HH was diagnosed in 45 patients after a median of 20 months (range, 0 to 101 months). The development of HH after MIE was comparable to the open approach (8% vs 5%, $p = 0.267$). At the time of diagnosis, 14 patients presented as a surgical emergency.

Of the remaining 31 patients, 17 were symptomatic and 14 were asymptomatic. An elective operation was performed in 10 symptomatic patients, and all others were treated conservatively. During conservative treatment, 2 patients presented as a surgical emergency. An emergency operation resulted in a prolonged intensive care unit stay compared with an elective procedure (3 vs 0 days, $p < 0.001$). In-hospital deaths were solely seen after emergency operations (19%).

Conclusions. HH is a significant long-term complication after esophagectomy, occurring in a substantial proportion of the patients. The occurrence of HH after MIE and open esophagectomy is comparable. Emergency operation is associated with dismal outcomes and should be avoided.

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Esophagectomy is the cornerstone of multimodality treatment for esophageal cancer. This includes dissection and removal of the esophagus, followed by restoration of the alimentary tract with a gastric tube in most patients [1, 2]. During this procedure, the normal anatomy around the esophageal hiatus of the diaphragm is disrupted, which could lead to an increased risk of developing a postoperative hiatal hernia (HH). A recent systematic review reported a mean HH incidence of 2.6%, occurring up to 32 months postoperatively [3]. This is likely to be an underestimate of the true incidence as a result of the limited long-term survival in the included studies and because some studies only reported rates of HH requiring surgical repair [3]. With improvements in overall survival resulting from the routine use of neoadjuvant treatment and modern-day esophageal cancer

operations [4], the development of HH after esophagectomy is becoming more relevant.

Minimally invasive esophagectomy (MIE) has been performed more frequently in recent years because of promising short-term outcomes such as decreased postoperative morbidity, shorter hospital stays, and faster recovery [2, 5, 6]. These potential benefits could be offset by short-term and long-term complications specific to the minimally invasive approach. There is surgical concern that HH presenting as a surgical emergency, with potentially catastrophic consequences, is increasingly being seen in patients who are long-term survivors after MIE [7–9]. The aims of the current study were to document the occurrence and clinical course of HH after open esophagectomy and MIE.

Patients and Methods

Study Population

Consecutive patients treated with transhiatal or trans-thoracic esophagectomy, followed by gastric tube reconstruction, at 2 designated cancer centers from the United Kingdom (UK) and the Netherlands were reviewed (October 2000 to December 2014). All patients were

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*Drs Brenkman and Parry are co-first authors; Drs Underwood and Ruurda are co-senior authors.

Address correspondence to Dr Ruurda, University Medical Center Utrecht, PO Box 85500, 3508 GA Utrecht, the Netherlands; email: j.p.ruurda@umcutrecht.nl.

Abbreviations and Acronyms

AO	= aorta
ASA	= American Society of Anesthesiologists
BMI	= body mass index
CI	= confidence interval
CIS	= carcinoma in situ
CRTx	= chemoradiotherapy
CT	= computed tomography
CTx	= chemotherapy
GEJ	= gastroesophageal junction
GT	= gastric tube
HH	= hiatal hernia
MIE	= minimally invasive esophagectomy
OR	= odds ratio
PSM	= propensity score matched
UHS	= University Hospital Southampton
UK	= United Kingdom
UMC	= Utrecht University Medical Center Utrecht

diagnosed with a clinically resectable tumor (cT1a to T4a N0 M0) according to the American Joint Committee on Cancer Tumor Node Metastases (TNM) staging system [10]. Excluded were patients who underwent a hybrid procedure (n = 37) or who died in the hospital during the postoperative course. Institutional Review Board approval for both centers was obtained, and informed consent requirement was waived for this study.

Neoadjuvant therapy was given to eligible patients with locally advanced tumors ($\geq T2$ or N+) and consisted of perioperative chemotherapy or neoadjuvant chemoradiation, as previously described [4, 11]. In the UK, most patients received perioperative chemotherapy. In the Netherlands, most patients received perioperative chemotherapy before 2012. Thereafter, due to the results of the Chemoradiotherapy for Oesophageal Cancer Followed by Surgery Study (CROSS), most patients received neoadjuvant chemoradiotherapy.

Surgical Procedure

All patients underwent an esophagectomy with gastric tube reconstruction, including Ivor Lewis, McKeown, and transhiatal esophagectomy. All types of procedures were performed minimally invasive and open based on institutional, surgeon, and patient preference. The McKeown and transhiatal approach were predominantly performed at University Medical Center Utrecht (UMC Utrecht), the Netherlands, whereas the Ivor Lewis procedure was predominantly performed at University Hospital Southampton (UHS), UK. The surgical procedures were performed as previously described [6, 12]. In the UMC Utrecht, a robot-assisted minimally invasive transthoracic approach is used in case of a MIE. This includes a robot-assisted thoracoscopic phase in the left lateral decubitus position, with 3 ports placed for the robot and 2 ports for the assistant. For both the abdominal phase of the transthoracic esophagectomy and for the transhiatal

esophagectomy, the patient is placed supine, and 5 ports are used for dissection and lymphadenectomy. After that, the left paraumbilical trocars port is widened to a 5- to 7-cm transverse transabdominal incision for removal of the specimen [12].

In the UHS, the Ivor Lewis procedure starts with abdominal laparoscopy with the patient supine through 5 ports for gastric mobilization and lymphadenectomy. After that, a thoracoscopic esophageal mobilization and mediastinal lymphadenectomy, using 3 ports, is performed with the patient prone. For removal of the resected specimen, the lower most thoracic port is enlarged to 3 to 6 cm [6].

In both centers, a 4- to 5-cm gastric tube was constructed and positioned prevertebrally in the esophageal bed. Cruroplasty and fixation of the gastric tube were not performed in any patient. The intraoperative techniques were comparable for open esophagectomy and MIE.

Evaluation of HH

Postoperative follow-up of all surviving patients took place every 3 months in the first year, every 6 months in the second and third year, and every 12 months thereafter until discharge of follow-up after 5 years. According to national guidelines, patients did not undergo routine imaging during follow-up, but only underwent radiologic imaging or endoscopy if they had symptoms suggestive of tumor recurrence or long-term complications [13–15]. To identify HH, all computed tomography (CT) reports of patients who underwent a scan 2 months or more postoperatively were reviewed.

HH was defined as herniation of abdominal organs other than the gastric tube into the thorax. The electronic patient records were reviewed to evaluate the clinical course associated with HH, including clinical presentation, treatment, and postoperative course after surgical repair. Patients were considered symptomatic if imaging was performed for symptoms that might have been attributable to HH (eg, pain, dysphagia, vomiting, or dyspnea). Patients who underwent imaging for other indications were defined as “asymptomatic.” The percentage of HH was calculated in patients who had a follow-up CT scan and in all patients.

HH Treatment

During the study period, there was no standardized treatment protocol for HH after esophagectomy. Asymptomatic patients were generally treated with a watchful waiting policy (conservative management). The treatment of symptomatic patients was determined by individual assessment of symptoms, patient fitness, risk factors, and prognosis. Surgical repair of HH was performed through an open or minimally invasive abdominal approach. During the procedure, the content of the HH was dissected completely from the mediastinal structures and returned to the abdomen, the hiatal defect was repaired by approximation of the left and right crus, and a mesh was performed according to the surgeon’s preference. Lastly, the gastric conduit was attached to the crus.

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