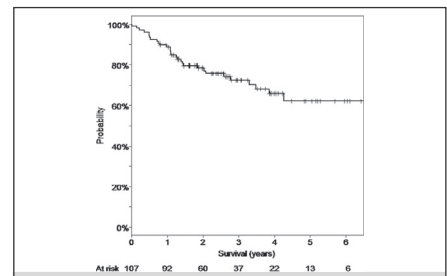


The 3-Hole Minimally Invasive Esophagectomy: A Safe Procedure Following Neoadjuvant Chemotherapy and Radiation

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Induction therapy followed by esophagectomy has become standard for treatment of intermediate-stage esophageal cancer in many centers. Herein we evaluate the feasibility and safety of the 3-hole minimally invasive esophagectomy (3HMIE) approach in patients who received induction radiation and chemotherapy. Between 2003 and 2012, the records of 119 consecutive patients with esophageal cancer who underwent 3HMIE were reviewed for perioperative complications and long-term outcomes. Comparison was made between procedures performed for patients receiving neoadjuvant chemoradiation and patients who were treated with only surgery. Of them, 78 patients received neoadjuvant chemoradiation and 41 patients were treated with only surgery. Tumor locations were upper (2), middle (16), distal (64), and gastroesophageal junction (37). In all, 76 patients were at clinical stage IIA or above at presentation. Increased requirement for blood replacement in the induction therapy group was significant compared with the surgery-only group. Operative time, estimated blood loss, proximal and distal margin lengths, and length of stay were not significantly different between the cohorts. There was a 30-day perioperative death (0.8%), and this patient was from the surgery-only group. No conduit necrosis or need for diversion was recorded. Overall, 5-year survival was 62% among the 107 patients with early-stage esophageal cancer. 3HMIE is feasible with low mortality and acceptable morbidity even in patients with locally advanced esophageal cancer who received neoadjuvant radiochemotherapy. Overall perioperative and survival outcomes are similar to or better than those reported in the published literature on esophagectomy after induction therapy.

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Overall survival for 107 patients with cancer of pathologic stage 0–2.

Central Message

Neoadjuvant CRT and MIE have become more prevalent in practice for the treatment of esophageal cancer. 3HMIE can be safely performed in patients treated with not just induction chemotherapy but also radiation with good outcomes.

Perspective

MIE is safe and feasible in patients after receiving both neoadjuvant chemotherapy and radiation therapy. This study describes the experience of a high-volume center that has achieved low mortality and acceptable morbidity in comparative cohorts of patients who received neoadjuvant treatment and no treatment before surgery. The perioperative and survival outcomes presented are similar to or better than those reported in the published literature on esophagectomy after neoadjuvant therapy.

See Editorial Commentary pages 216–217.

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THE 3-HOLE MINIMALLY INVASIVE ESOPHAGECTOMY

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INTRODUCTION

During the past 2 decades there has been an increasing incidence of esophageal cancer in the western world, thought to be related to the corresponding increase in prevalence of Gastroesophageal Reflux Disease, Barrett's esophagus, and obesity—all risk factors for esophageal adenocarcinoma.¹⁻³ The increasing incidence of adenocarcinoma affecting mostly the distal esophagus and the gastroesophageal junction has made esophageal cancer the eighth most common malignancy in the United States. Surgical resection remains the gold standard treatment of early and locoregionally advanced, non-metastatic, middle, and distal esophageal cancer.

Multiple surgical approaches have been used to accomplish esophagectomy. The differences among them relate to the techniques of approach to the thoracic esophagus, the extent of resection and lymphadenectomy, and the site of the anastomosis. Regardless of the approach used, esophagectomy continues to be a relatively high-risk and complex operation, particularly in the postchemoradiation (CRT) setting. Pulmonary complications, in particular, remain high, increasing the postoperative mortality rates.^{4,5}

General advances in laparoscopic and thoracoscopic skills as well as innovative tools prompted some surgeons to perform minimally invasive esophagectomy (MIE). Various operations have been performed using the minimally invasive approach, such as Ivor Lewis, transhiatal, and the 3-incision esophagectomy.^{4,6-10} Since the initial reports by Luketich et al,^{12,11} several other clinical series have shown beneficial results of MIE, claiming decreased postoperative complications.^{7,13} However, most of the initial cases have been early-stage cancers, high-grade dysplasia, or patients undergoing neoadjuvant chemotherapy alone. Only a few groups have used this approach for the more locally advanced esophageal malignancies, treated before surgery with neoadjuvant CRT combination therapy,^{14,15} which has been thought to be associated with higher rates of perioperative complications.^{14,15}

To address the paucity of published large series of minimally invasive “3-hole esophagectomy” in the setting after neoadjuvant CRT therapy, we focus herein on this specific group. The aim of this study was to demonstrate the feasibility of performing a MIE in patients who have been treated with neoadjuvant radiation as other published series have focused on patients treated with only neoadjuvant

chemotherapy. We present our technique, which is a slight modification of published ones, as well as the operative, oncologic, short, and long-term results and advantages of the MIE approach in this setting.

METHODS

Patients and Data

As of 2005, a prospective database of all esophagectomy cases performed at the Division of Thoracic Surgery at our institution has been maintained. In addition, the entire retrospective data set of all esophageal surgeries at our institution since 1988 was linked with the prospective database with institutional review board approval. All patients who underwent thoracoscopic and laparoscopic minimally invasive esophagectomy (3HMIE) from May 1, 2003 until June 30, 2012 were included in this study. Each patient's medical record was reviewed for demographic and clinical data. Operative parameters included estimated blood loss (EBL), procedure duration, intraoperative complications, and operative technique. The records were also assessed for perioperative and pathologic data including extubation time, intensive care unit stay, transfusion needs, length of hospital stay, postoperative complications, 30- and 90-day postsurgery mortality, histology, pathologic staging, number of lymph nodes resected, and number of involved lymph nodes. Patients were staged according to the American Joint Committee on Cancer classification, seventh edition. The cohort was then divided into 2 groups: patients who received neoadjuvant CRT and the patients who had surgery alone.

Fisher's exact and Wilcoxon rank-sum tests were used to compare the 2 groups to evaluate any differences in the preoperative characteristics as well as intraoperative and perioperative outcomes, depending on whether the data are categorical or continuous. The 30-day and 90-day mortalities are defined, respectively, as death during the first 30 and 90 days following the date of surgery. Follow-up duration was defined from the date of surgery until the date of death or last documented follow-up; the cutoff date for follow-up was August 13, 2013. Overall survival was estimated by the Kaplan-Meier method, with censoring of patients who have not died. Median follow-up was reported among all patients still alive. The difference between stage groups was assessed by the log-rank. All *P* values are based on a 2-sided hypothesis. Statistical analysis

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