Evaluation and patient selection for minimally invasive esophagectomy

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Abstract: Minimally invasive esophagectomy (MIE) is an evolving surgical alternative to traditional open esophagectomy. Despite considerable technical challenges, it was considered that MIE could be performed effectively by surgeons experienced in open esophageal resection and advanced laparoscopic surgery. This chapter illustrates the preoperative evaluation and operative indications of MIE for esophageal cancer. Firstly, a complete history and physical exam is required for counseling on preoperative optimization. Then, the operation can be conducted after standard preoperative work-up includes several parts, such as positron-emission tomography (PET), endoscopic ultrasound (EUS), esophagography and computed tomography (CT). To our knowledge, the operative indications for MIE is now extended due to the rapid development of surgical technique and detailed preoperative evaluation. Limited node invasion and neoadjuvant chemoradiation are not rigorous contraindications for MIE any more. Optimal results require elaborate evaluation, appropriate patient selection and a multidisciplinary team experienced in the management of esophageal cancer.

Keywords: Preoperative evaluation; minimally invasive esophagectomy (MIE); operative indication

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Introduction

Minimally invasive esophagectomy (MIE) techniques involve either complete endoscopic resection, via a thoracoscopic or laparoscopic approach, or a hybrid approach in which one part of the procedure is performed endoscopically. The principal purpose of MIE is to reduce surgical trauma and its effect on postoperative quality of life, rather than to expand the indications for surgery (1). Compared with open esophagectomy, MIE has advantages with respect to blood loss, operative trauma, postoperative recovery time and hospital stay (2,3). However, given the relatively high risk of surgery-related morbidity, adequate preoperative evaluation and patient selection are essential for MIE (4).

Preoperative evaluation

Patients in our institution are selected for MIE after the following standard preoperative work-up.

History and physical examination

There is no substitute for a careful history and physical examination performed by an experienced clinician. In our institution, a complete history and physical examination is performed, with particular attention to the severity of dysphagia. The clinicians evaluating a patient for MIE have several purposes during the evaluation process. First, the most important is to provide all parties with an assessment of both the short- and long-term risks of morbidity and

mortality from the MIE procedure and to simultaneously identify factors that can be addressed to reduce the possibility of adverse events. In addition, the comprehensive evaluation of a patient as part of the preoperative assessment allows the identification of risk factors and health issues, such as diabetes, high blood pressure, and heart or lung problems, that should be under control.

Upper endoscopy

During the preoperative assessment, the most important aspect is to perform complete upper endoscopy and biopsy of the lesion to confirm the presence of a resectable esophageal lesion and to obtain pathological diagnosis (5). Deep biopsy with an endoscopic technique is a safe, high-yield, diagnostic method in patients with esophageal tumors. Pathologic confirmation may improve clinical decision making in the management of the patient (6). Kawamura and colleagues reported that endoscopists who do not allot adequate examination time may overlook neoplastic lesions in the upper gastrointestinal tract (7).

CT and PET/CT scanning

Since the overall accuracy rates of computed tomography (CT) scanning for the assessment of the depth of esophageal cancers are relatively poor, CT scanning is used to identify distant metastases and suspicious regional nodes rather than tumor depth (8). In our institution, CT scanning is used to evaluate the extent of lymph node involvement and distant metastasis. Before the advent of CT scanning for the staging of esophageal cancer, other noninvasive tests including linear tomography and nuclear scintigraphy accurately staged esophagus cancer in less than 30% of cases (9). Moreover, CT scanning may be useful to predict the efficacy of preoperative chemotherapy and the subsequent prognosis for patients with advanced esophageal cancer (10). New interest is developing in staging based on tumor measurements made on radiographs, with assessment of treatment response based on tumor length (9).

Routine CT scanning has improved the detection of distant metastases, but it generally has been replaced by the more sensitive PET/CT (positron emission tomography/computer tomography). The minimum lesion size that can be detected by PET scan alone is 5 mm; however, with PET/CT, there may be improvements in the resolution because lesion size and intensity influence detectability (11). PET is very sensitive in more than 95% of cases for detecting primary tumors if the primary tumor is hypermetabolic (12,13). One of the major advantages of PET over CT is the three-dimensional imaging that can be accomplished with PET. This modality is also more likely than CT to identify secondary tumors (14). PET is not typically used to diagnose esophageal cancer; however, it is used to evaluate regional nodal disease and distant metastases. Just as endoscopic ultrasound (EUS) contributes to the preoperative evaluation and management of the new esophageal cancer patients, PET/CT adds additional biological information about the primary tumor as well as important staging information (15). FDG PET/CT scanning is valuable for assessing treatment response after neoadjuvant chemotherapy and predicting survival outcomes after surgery (16).

EUS

EUS staging of esophageal cancer was firstly reported by Lightdale in 1992 (17). In the next decade, the modality became a standard part of staging and follow-up of esophageal cancer in newly diagnosed patients (18,19). Although clinical signs and symptoms can determine T stage with a fair degree of accuracy, with substernal chest pain, dysphagia, and weight loss all being highly suggestive of T3 or T4 disease, symptoms alone are probably not enough to determine surgical resectability (20). EUS remains the most accurate modality for determination of T stage, with accuracy rates ranging from 64% to 80% with a low-frequency probe and up to 85% to 92% with a high-frequency probe (21). In studies with pathologic confirmation, the accuracy rates of EUS for determining N stage range from 70% to 86% (22). With the increased utility of preoperative chemoradiation, EUS can help to determine the locoregional stage of the cancer so that neoadjuvant treatment can potentially be offered to those with locally advanced disease (23). In addition, EUS is also helpful for confirming metastases to the celiac lymph nodes, which determines stage IV cancer (24).

Recently, with the widespread use of endoscopic therapy for early esophageal cancers, accurate staging of T1 adenocarcinoma with EUS is important to determine which patients may be offered endoscopic therapy for a potential cure and which patients should undergo esophagectomy. In experienced EUS groups, the accuracy of staging of intramucosal (T1a) cancer ranged from 82% to 94% (21,25). A T1b tumor has an approximately 20% likelihood of lymph node metastases compared with intramucosal

lesions, which have a less than 5% likelihood; thus, the EUS assessment of T stage may be helpful in deciding between endoscopic treatment and surgical resection (26). Performing EUS before endoscopic resection of T1 tumors remains controversial, and resection may be diagnostic (27).

Esophagography

Esophagography, which is also known as a barium swallow, is the radiographic or fluoroscopic examination of the pharynx and the esophagus after ingestion of thick and thin mixtures of barium sulfate, respectively. This test, which is commonly performed as part of an upper GI series, is indicated for patients with a history of dysphagia and regurgitation. The purpose is to diagnose hiatal hernias, diverticula, strictures, ulcers, tumors, and motility disorders. However, with regard to esophageal cancer, further testing is usually required for a definitive diagnosis (28).

In summary, preoperative evaluation using imaging techniques, such as EUS, CT and PET/CT scanning, remains the mainstay for the diagnosis of esophageal cancer (8). In addition, esophagography can be used to confirm the location of the lesion and evaluate the continuity of esophagus. Complete and appropriate evaluation of esophageal cancer can improve the selection of patients for MIE and may improve patient outcomes (29).

Patient selection

Although MIE has been widely used for nearly 20 years, there are not yet specific criteria regarding the indications for MIE. In general, MIE is indicated in the same patients as open techniques with a few exceptions (30). It should not be undertaken in patients who are unable to survive the physiological insult of surgery. Evaluating individual risk is important for patient selection and proper preoperative management. A critical component of the preoperative evaluation is the assessment of a patient's functional status. Functional status is an important component of the decision algorithm for both the pulmonary and cardiac elements of the preoperative evaluation (31). It is not easy to predict which patients will develop with complications after surgery. Even so, we must know which indicators can increase postoperative morbidity and mortality. Many risk factors have been identified including poor cardiopulmonary function, advanced age, tumor stage, diabetes mellitus, impaired general health, and hepatic or renal dysfunction (32).

Combined with the previous reports and our experiences at home and abroad, the following items are considered as common indications for MIE: (I) early or middle stage esophageal cancer that does not invade the full thickness of the esophagus; (II) no severe pleural adhesions; (III) lesion diameter <5 cm; (IV) lesion diameter >5 cm with the lesion mainly within the esophageal lumen; (V) no adjacent lymphadenopathy or distant metastasis.

Tumor staging is essential for planning surgical treatment, and surgery should not be performed in patients without a chance of cure such as in those with distant metastases or in those unable to survive the physiological insult of surgery. The main objective of surgery must be to achieve a R0 resection. For thoracic surgeons, particularly those who are still learning MIE, it is very important to choose patients according to tumor staging. Generally, patients with a clinical stage of $T_{1\text{-}3}N_{0\text{-}1}M_0$ (AJCC TNM staging) are suitable for direct surgery. Patients with locally advanced esophageal cancer can receive neoadjuvant chemoradiation followed by MIE. Currently, neoadjuvant chemoradiation plays a key role because it downstages the tumor and allows for adequate tumor resection. From a surgical perspective, the drawback is that neoadjuvant chemoradiation may further complicate the procedure by causing significant fibrosis, which necessitates an important discussion about the effectiveness of MIE in these situations. However, in a multicenter, open-label, randomized controlled trial published in 2012 by Biere *et al.* that compared open surgery with MIE for advanced tumors in a similar number of patients, there were not significant differences between groups in terms of the margins obtained after resection (33). Moreover, the recent literature does not show that neoadjuvant treatment is a contraindication for minimally invasive techniques (34). Thus, a minimally invasive approach would not be a contraindication for patients with advanced stages of cancer.

Overall, the field of MIE is stirring, and innovations continue to occur in rapid succession. At this moment, the most prominent question is related to long-term outcomes. Studies on the indications and contraindications for MIE are required to explicit the specific selection criteria for MIE.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE

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