Minimally invasive esophagectomy

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Abstract. Introduction. Open esophagectomy is associated with significant mortality and morbidity, even in experienced centers. Two of the more frequent complications following esophagectomy are pneumonia and respiratory failure. Single-institution series have suggested that the incidence of these complications may be decreased with minimally invasive esophagectomy, with equivalent survival compared to open esophagectomy. However, this operation is technically challenging. In this review we detail the procedure as performed in our center, and also discuss some recent developments.

Since the initial description of laparoscopic fundoplication in 1991 [1], esophageal surgeons have increasingly incorporated minimally invasive surgery into their practice. This has been supported by several surgical series that have documented the benefits of minimally invasive surgery for the treatment of gastroesophageal reflux disease [2–4] and achalasia [5–7]. A consistent finding of these reports has been the equivalent efficacy and decreased recovery times of laparoscopic surgery compared with traditional open surgery. These reports have led to increasing surgical referrals for the management of these

lessen complications and improve survival. The learning curve is steep. Proper port placement, patient positioning, and facile use of mechanical staplers is mandatory. However, the largest published series to date of minimally invasive esophagectomies [MIE] showed a 1.4% mortality rate, an 11% anastomotic leak rate, and lowered lengths of stay. The evolving Pittsburgh experience has resulted in technical modifications like narrower gastric pouches, Ivor Lewis type anastomoses, and more complete lymph node resection.

Conclusions: This paper discusses the background, techniques, challenges, and future direction for using this technique to treat esophageal disease.

Key words: Minimally invasive esophagectomy, esophageal cancer.

Introduction

Open esophagectomy is associated with significant mortality and morbidity, even in experienced centers. Two of the more frequent complications following esophagectomy are pneumonia and respiratory failure. Single-institution series have suggested that the incidence of these complications may be decreased with minimally invasive esophagectomy, with equivalent survival compared to open esophagectomy. However, this operation is technically challenging. In this review we detail the procedure as performed in our center, and also discuss some recent developments.

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diseases, even though alternative medical therapies are available [8].

Although laparoscopic surgery for benign esophageal disease has met with widespread acceptance, this has not been the case for esophageal cancer. However, minimally invasive surgery offers several potential benefits for these patients. First, open esophagectomy is associated with a significant morbidity and mortality, even in experienced centers [9]. Two of the more frequent complications following esophagectomy are pneumonia and pulmonary failure. These complications are associated with significant mortality. Indeed patients who develop pneumonia following esophagectomy face up to a 20% risk of death [10]. The avoidance of laparotomy and thoracotomy incisions may very well impact on the incidence of these complications. Although no randomized studies have been performed, our experience and that of others has suggested that minimally invasive esophagectomy (MIE) is associated with a lower rate of major complications and a lower mortality than that reported following open esophagectomy [11].

Second, the significant morbidity associated with open esophagectomy has led to increasing interest among medical oncologists to treat patients with definitive chemoradiation alone. Two recent studies on squamous cell cancer of the esophagus lend some support to this practice [12, 13]. The impact of these reports has been to recommend non-operative therapy for marginal surgical candidates, such as the elderly or those with multiple comorbidities. Indeed the National Comprehensive Cancer Network in their recent guidelines now considers definitive chemoradiation to be an acceptable alternative to esophagectomy [14]. Unfortunately, some of this data has been extrapolated to healthy patients with high-grade dysplasia or early-stage esophageal cancer in whom very high 5-year survival rates can be anticipated after esophagectomy. With these challenges, it is incumbent on esophageal surgeons to refine the technique of esophagectomy, in order to offer therapy with either lower morbidity, improved survival, or both, compared with traditional esophagectomy.

The technique of minimally invasive esophagectomy (MIE) has evolved as our experience with other minimally invasive foregut procedures, such as laparoscopic Heller myotomy, repair of giant paraesophageal hernias, and staging for esophageal cancer, has grown. Currently, we have performed over 500 MIEs at the University of Pittsburgh Medical Center, US.

Initial attempts at MIE were hybrid operations combining traditional open surgery with minimally invasive techniques. The first such report by Collard in 1993 included 12 patients who underwent thorascopic mobilization of the esophagus followed by laparotomy and preparation of the gastric conduit [15]. In that series, two patients required conversion to thoracotomy for bleeding. Several subsequent reports have demonstrated the feasibility of this approach; however, no definitive benefit has been shown compared to open esophagectomy [16, 17].

A completely laparoscopic transhiatal esophagectomy has also been described. The largest series, published by DePaula et al., in 1995 [18], described 48 patients who required esophagectomy predominantly for end-stage achalasia secondary to Chagas’ disease. Only two patients required conversion to laparotomy. The first experience with MIE in the US was not reported until 1997, when Swanstrom described a carefully selected group of nine patients with small tumors, benign strictures and Barrett’s disease [19]. Eight of these patients had a totally laparoscopic transhiatal esophagectomy, while one required the addition of a right video-assisted thoracic surgery (VATS) procedure.

Similar to these early reports, our initial efforts at minimally invasive esophagectomy were through the transhiatal approach. However, while this simplifies patient positioning and does not require single-lung ventilation, we found that the disadvantages were significant. The small working space through the hiatus allowed only limited access to the middle and upper third of the esophagus, and made any thoracic lymph node dissection extremely difficult. Because of this, our current approach includes a right VATS to mobilize the thoracic esophagus followed by laparoscopy to prepare the gastric tube. Although early in our experience, MIE was only offered to patients with Barrett’s disease and early-stage tumors; we now offer MIE to patients with more advanced disease. Patients found to have bulky nodal metastases by CT scan or staging laparoscopy are not felt to be candidates for MIE, and consideration is given to either an open operation or definitive chemoradiation.

**Surgical technique**

The initial step in MIE is an on-table esophagogastroduodenoscopy (EGD) to confirm the tumor’s location and the suitability of the stomach as a conduit for reconstruction. Significant extension onto the cardia of the stomach will often require a wider gastric resection margin and may prevent the construction of a gastric conduit that will