

## The Role of the Thoracic Surgeon in Minimally Invasive Esophageal Surgery: Past, Present and Future

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Minimally invasive surgery (MIS) of the esophagus is now rapidly being adopted by thoracic surgeons. In the past, many thoracic surgeons were reluctant to adopt less invasive techniques due to concern over the potential for poor outcomes compared to established open procedures. This conservative stance was well founded since traditionally, good outcomes following esophageal surgical procedures required significant technical expertise. Since most thoracic surgeons had little experience with laparoscopic or thoracoscopic techniques, they were not prepared to carry out complex minimally invasive procedures. General surgeons, on the other hand by the late 1980's, were gaining significant experience with laparoscopic cholecystectomy and began to explore less invasive techniques for more complex procedures. Advances in technology for hemostasis and intracorporeal suturing allowed general surgeons to perform laparoscopic Nissen fundoplication for gastroesophageal reflux disease with reasonable short-term outcomes reported by the early 90's. This led to a paradigm shift for the treatment of benign diseases of the esophagus from thoracic surgeons to general surgeons. Over the last few years, however, thoracic surgeons have progressively embraced the technological advancements and now are beginning to play an important role in developing minimally invasive approaches to some of the most complex procedures for esophageal disorders, including giant paraesophageal hernias, achalasia and esophageal cancer.

As with open surgery, technological advances have spearheaded much of the progress made in the minimally invasive surgical era. Essential components included endoscopic video capability to provide enhanced visualization of body cavities and organs through a minimally invasive approach advanced endoscopic instruments and stapling devices. While basic thoracoscopy was first in-

troduced in 1921 by Hans Christian Jacobaeus for the management of tuberculosis,<sup>1)</sup> widespread acceptance of thoracoscopy awaited improvements in endoscopic video capability. Gynecologists embraced this concept for minor pelvic procedures by the 1970's but the growth of laparoscopic procedures in the late 80's and early 90's after Mouret (1987) reported the first laparoscopic cholecystectomy led to more widespread acceptance of MIS.

Over the past few years, many thoracic surgeons have acknowledged the potential benefits of MIS and have adopted a keen interest in both laparoscopy and video-assisted thoracoscopy for the esophagus but continue to question the long-term durability of these procedures. The surgical community must continue to assess not only short-term outcomes of reduced morbidity, equal or reduced mortality, reduced length of hospital stay and reduced convalescent period, but long-term outcomes must be continued to be studied as well.

The development of MIS centers, that combine the talents of both general and thoracic surgeons, have been instrumental in widening the scope of procedures and acceptance of MIS by patients and surgeons alike. Presently, MIS is being widely utilized for a variety of benign and malignant esophageal diseases and is now second only to biliary tract surgery in the frequency of minimally invasive procedures performed. Laparoscopic fundoplication was first reported in 1991,<sup>2,3)</sup> and is presently accepted as an effective treatment to control reflux symptoms with a success rate of 90-93% at intermediate follow-up of 18-24 months.<sup>4-6)</sup> MIS is now being adopted more widely for complicated esophageal cases including esophagectomy, paraesophageal hernias and re-operations for failed anti-reflux procedures.

Collis gastroplasty is now routinely performed laparoscopically at our institution for patients with a shortened esophagus frequently found in association with a large paraesophageal hernia. In our laparoscopic experience we liberally employ Collis gastroplasty and have reported good to excellent results in 200 patients with giant paraesophageal hernias.<sup>7)</sup> The median length of stay was 3 days with a complication rate less than that of most

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open series. There was one death and five patients required re-operation for hernia recurrence esophageal structuring or redo anti-reflux surgery. We have also reported our experience with minimally invasive esophagomyotomy for achalasia in 62 patients.<sup>8)</sup> A laparoscopic heller myotomy with a Toupet fundoplication is our procedure of choice, with relief of dysphagia in 92.5% of patients. The median length of stay was 2 days. There were 6 intraoperative perforations in our early experience, but no postoperative leaks or deaths.

Presently, only a hand full of centers in North America have published their experience with minimally invasive esophagectomies which have been performed since 1995 employing a variety of techniques.<sup>9,10)</sup> The adoption of MIS for esophageal cancer has been a slower process than for benign disease partly due to the greater technical difficulty of this procedure. Our current approach includes right video-thoroscopic mobilization followed by a laparoscopic transhiatal esophagectomy with the standard left neck incision. Our experience with the first 77 cases has been published.<sup>11)</sup> The mean operative time was 7 hours with a mean hospital stay of 7 days. Twenty-seven patients had major complications and the 30-day mortality was zero. The overall survival was 81% at a median follow-up of 20 months. We are presently in the process of reporting our results in over 200 cases. The current average operating time is less than 5 hours and the average hospital stay is 6 days.

Thoracic surgeons have a very important role in the evolution of minimally invasive esophageal surgery. New solutions to the obstacles of converting complex open procedures to MIS approaches are inevitable. Significant efforts are being made to develop three-dimensional imaging to improve depth perception and coordination of fine surgical movements which will facilitate robotic surgery. Actively controlled high-speed shutter glasses may prove to be the visual system of the future.<sup>12)</sup> The development of tactile sensors on instruments may help compensate for the loss of direct finger contact inherent to MIS. The ability to assess the mechanical qualities of tissues and organs is an important aspect of open surgery that many surgeons have grown to rely upon. Instruments that can be steered may also be an advantage, returning the natural six degrees of freedom of movement experienced by surgeons in open procedures. Instruments and cameras will also likely improve in size and quality over time, and may address the debate of disposable versus reusable equipment. Thoracic surgeons need close cooperation with industry to ensure the responsible and stepwise

introduction of these new technologies.

To ensure optimal patient care, thoracic surgeons need to play an important role in the training and the subsequent credentialing of surgeons to perform these minimally invasive procedures. At the University of Pittsburgh we have developed a minimally invasive center for general and thoracic surgeons with the goal of education, training and research into the techniques and outcomes of laparoscopic and thoroscopic procedures. Councils of the American Association for Thoracic Surgery and the Society of Thoracic Surgeons have formed a Joint Committee on Thoracoscopy and Video-assisted Thoracic Surgery to provide guidelines on training and surgeon performance. Adequate performance requires a significant and focused training commitment. Since the chances of conversion to an open procedure always exists with MIS, video-assisted thoracic surgery should be performed only by surgeons who are qualified to perform open thoracic surgical procedures and are able to manage their potential complications.

Over the past decade, tremendous progress has been made in MIS, due in large part to a sharing of ideas between surgeons, industry leaders, and institutions. MIS presently has a wide range of applications to the esophagus and is quickly becoming the standard of care for the management of many esophageal diseases at experienced centers. With the rapid development of new technologies and the potential expansion of accepted applications, the thoracic surgeon is pivotal to ensure that minimally invasive esophageal surgery has a long, safe and prosperous future.

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