Robotic-Assisted Minimally Invasive Esophagectomy
The Ivor Lewis Approach

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KEYWORDS

• Esophageal cancer • Minimally invasive esophagectomy • Robotic surgery • Esophagectomy

KEY POINTS

- Robotic-assisted minimally invasive esophagectomy (RAMIE) is emerging as an alternative to minimally invasive esophagectomy (MIE).
- Early retrospective reports suggest RAMIE Ivor Lewis is feasible, with short-term outcomes equivalent to those of open surgery or standard MIE.
- Potential pitfalls and complications, in particular during airway dissection and anastomotic creation, are avoidable and should be recognized.
- Prospective trials investigating safety, outcomes, and quality-of-life profiles for RAMIE are currently accruing.

Videos of Hiatal dissection, Retrogastric dissection, Pyloroplasty, Conduit formation, Esophageal mobilization, Subcarinal dissection, Creation of anastomosis: securing stapler anvil, Creation of anastomosis: stapling and completion accompany this article at http://www.thoracic.theclinics.com/

INTRODUCTION: NATURE OF THE PROBLEM

In patients with benign or malignant disease requiring esophagectomy, minimally invasive approaches to resection have become increasingly used, with a growing body of data documenting excellent outcomes in these patients.[1–3] At least 1 randomized prospective study has cited decreased pulmonary complications and improved perioperative outcomes with minimally invasive esophagectomy (MIE) in comparison with open resection.[4]

Although robotic approaches to these operations have been described, the published experience with robotic-assisted minimally invasive esophagectomy (RAMIE) remains small. Studies cite a wide range of surgical approaches, with an equally variable quality in the reporting of technique and outcomes, including complications.

At the authors' institution a RAMIE approach was initiated in 2010 with the primary goals as follows: (1) to maximize patient safety; (2) to allow controlled introduction of robotic technology to already established procedures, with critical, prospective examination of outcomes and adverse events; and (3) if feasible, to develop a standardized procedure potentially portable to other centers and surgeons performing these operations.[5] The procedure resulting from this process is described herein.

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SURGICAL TECHNIQUE

Preoperative Planning

All patients presenting with an endoscopy-confirmed and biopsy-confirmed diagnosis of esophageal carcinoma undergo rigorous preoperative evaluation to assess comorbidities and fitness for surgery. Staging is performed by means of computed tomography scanning of the chest, abdomen, and pelvis; endoscopic ultrasonography; and fluorodeoxyglucose-18 positron emission tomography scanning. Patients with early-stage lesions confined to the mucosa (T1a or less) are referred for diagnostic endoscopic mucosal resection and potentially therapeutic endoscopic resection with or without ablation of remaining Barrett mucosa. Patients with clinically early-stage lesions (T1b or T2 with no evidence of local lymph node metastases) are referred for surgery. Patients with clinically advanced local-regional disease (T3 and/or any N) are referred for induction chemotherapy and radiation, followed by surgical resection approximately 4 to 6 weeks after completion of treatment.

Preparation and Patient Positioning

The basic room setup for the abdominal and thoracic phases of the operation is depicted in Fig. 1. The robotic instrumentation cart is set up on the patient's right side, and the tower is set up on the left. The authors use a 4-arm robotic platform with 2 operating consoles. The operating surgeon and surgical trainee are positioned at the robotic consoles, and an assisting surgeon remains at the bedside. All patients receive an epidural catheter. An arterial line is placed routinely, and single-lung isolation with double-lumen tube intubation is performed routinely during the thoracoscopic phase. Upper endoscopy is performed before positioning, to assess the position of the tumor and the extent of gastric cardia and fundus involvement, if any.

For the abdominal phase, patients are placed supine on the operating table. The arms are placed at 45° on arm rests, and the patient is shifted to the right side of the bed to allow appropriate use of the liver retractor. Alternatively, to minimize interaction with the robotic assistant arm, the left arm may be tucked. A footboard is placed, and the patient is carefully secured to the table. Before the patient is prepped, the bed is briefly tested in steep reverse Trendelenburg position to confirm the stability of the patient on the table.

For the thoracic phase, the patient is placed in flexion in standard left lateral decubitus position, with the right side up and the upper arm in a neutral position. No prone positioning is used.

Surgical Approach and Port Placement

A combined sequential laparoscopic and thoracoscopic approach is used, as previously described.[5] For the abdominal approach, the operating table is turned 90° and brought into position to allow easy entry of the robotic cart and arms (da Vinci Surgical Robot; Intuitive Surgical Inc, Sunnyvale, CA) directly over the midline of the patient. A point approximately 1 to 2 cm above the xiphoid is marked in the midline. This point is used as a reference marker for the hiatus, the most cephalad of the abdominal phase, which all instrumentation

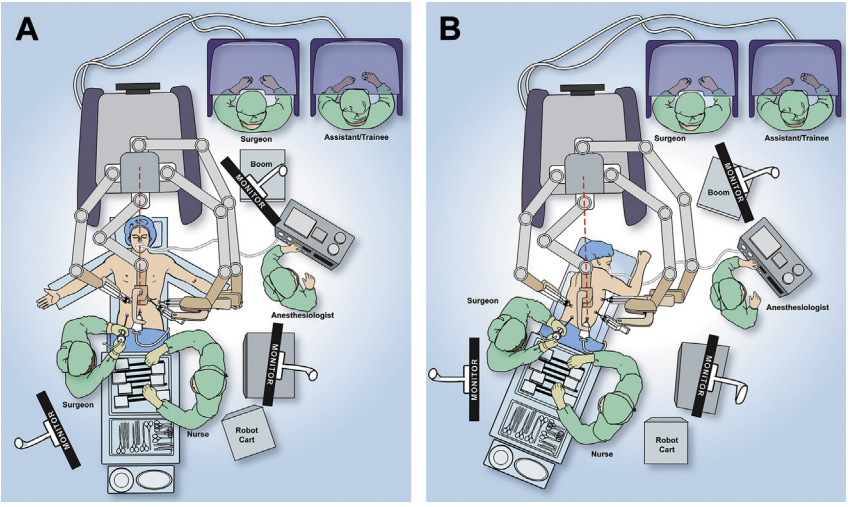

Fig. 1. Robotic-assisted minimally invasive esophagectomy (RAMIE) operating room setup for the abdominal (*A*) and thoracic (*B*) phases. (*Courtesy of* Memorial Sloan-Kettering Cancer Center, New York, NY; with permission.)