



# Minimally invasive esophagectomy—standard of care

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Minimally invasive resections for oncologic intent have been increasing over time and are being embraced by surgeons and patients. For esophagectomies, data from the National Cancer Database in the United States show an increasing adoption of the technique over time with 26.9% of esophagectomies performed using a minimally invasive approach in 2012 (1) compared to 55.9% in 2015 (2).

This trend favoring minimally invasive resection results from successes demonstrated in randomized and single-institution series of esophagectomies. The landmark TIME trial (3) randomized 115 patients to open (laparotomy and thoracotomy) versus minimally invasive (laparoscopy and thoracoscopy) esophagectomy, with approximately two-thirds of patients in each group undergoing cervical anastomoses. Minimally invasive esophagectomy (MIE) resulted in a lower rate of pneumonia within two weeks of surgery (9% MIE *vs.* 29% open,  $P=0.005$ ) and a shorter length of stay (11 days MIE *vs.* 14 days open,  $P=0.044$ ). The MIE group had a 14% conversion rate, and although estimated blood loss was less in the MIE group, the operative time was slightly longer. Lymph node yield and negative margin rates were similar between the groups. Post-operative complication rates were comparable except for significantly lower rates of pneumonia and vocal cord paralysis in the MIE group. The MIE group also had significantly improved quality of life and follow up from the study demonstrated no difference in 3-year disease-free or overall survival (4).

Within the last few months, the ROBOT trial (5) also reported encouraging results for robot-assisted minimally

invasive esophagectomy (RAMIE) using a three-field approach with cervical anastomosis. A total of 112 patients were randomized in this study. The RAMIE group had fewer modified Clavien-Dindo grade 2–5 complications (59% *vs.* 80%,  $P=0.02$ ) and lower rates of pneumonia (28% for RAMIE *vs.* 55% open,  $P=0.005$ ) and cardiac complications (22% *vs.* 47%,  $P=0.006$ ). RAMIE was associated a 5% conversion rate, less blood loss, but increased operative times. The RAMIE group had less postoperative pain and improved quality of life at discharge. Oncologic outcomes were comparable between the two groups.

The recently reported study by the Federation de Recherche en Chirurgie (FRENCH) and French Eso-Gastric Tumors (FREGAT) Working Group (6) randomized 207 patients with a planned Ivor Lewis esophagectomy to an open operation (diagnostic laparoscopy followed by laparotomy and thoracotomy) or hybrid operation (laparoscopy and thoracotomy). The conversion rate was 3%, and the two groups had similar operative times and lengths of stay. Nodal yield and margin status were comparable between groups. Major intraoperative and postoperative complications were experienced in 36% of the hybrid group and 64% of the open group (OR 0.31,  $P<0.001$ ), with significantly lower rates of major pulmonary complications in the hybrid group (18% *vs.* 30%). There were no statistically significant differences in disease-free or overall survival at three years although there was a trend favoring the hybrid group for both outcomes.

Both laparoscopic MIE and RAMIE have significant learning curves and successful adoption requires investment

of time and resources. The current study included only centers that had performed at least 25 MIEs and therefore, the results are applicable to centers with some experience—the identical operative time and low conversion rate in the hybrid MIE trial is likely reflective of the experience of the involved centers. Hybrid MIE shows clear benefit over open esophagectomy although the reported rate of pulmonary complication (18%) is still higher than the rate reported in the MIE group of the TIME trial (9%) despite similar rates in the open groups of both trials (29% and 30%). Although it is difficult to compare these two trials given differences in technique and reporting, both complete and hybrid MIE techniques are significantly better than open esophagectomy with decreased complication rates, improved quality of life, and comparable oncologic outcomes. These minimally invasive approaches should be considered the standard of care for patients undergoing esophagectomy and can be completed as planned in most patients.

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### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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