Risk Adjustment and Performance Measurement for Esophageal Cancer Resection

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KEYWORDS

- Esophageal resection • Risk adjustment • Enhanced recovery pathway • Composite score

KEY POINTS

- A straightforward model for predicting outcomes after esophageal resection has proved difficult to identify.
- Prolonged hospital length of stay after esophageal cancer resection has been linked to increased morbidity, mortality, and resource utilization.
- Postoperative complications are associated with a longer length of hospital stay, increased hospital cost, and decreased survival.
- Neither hospital nor provider volume alone can predict outcomes reliably.
- Composite quality measures may provide a benchmark by which outcomes are compared.

INTRODUCTION

Risk adjustment and performance measurements aim to identify a means of achieving high-quality outcomes for patients undergoing esophageal cancer resection. These outcomes are affected by factors related to (1) patients and the disease and (2) the system in which they are treated. Disease-related factors, a patient's health status, and the type of operation influence postoperative complications. Although these factors can be identified in studies, they are not always easily modifiable in an individual patient. System-related factors include surgical team experience and aspects of the health system pertinent to care and treatment of a particular disease. Such elements are the focus for patients, families, and referring physicians deciding how to proceed with health care.

DISEASE-RELATED FACTORS AND RISK ADJUSTMENT

A valid and reliable model for predicting outcomes after esophageal resection has proved difficult to identify, although many models have attempted to address this issue. A recent review article identified more than 10 proposed models, all with similar limitations to clinical application: the lack of high-volume of rare complications and high-quality validation and reproducibility.[1] This review included the Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM). This model was initially created for risk stratification in general surgery and was found to overpredict mortality in esophageal resection. The POSSUM physiologic score is obtained by a calculation, including the following variables: age, chest radiograph, systolic blood

pressure, heart rate, Glasgow Coma Scale, hemoglobin, white blood cell count, urea, sodium, potassium, and an electrocardiogram. An additional more refined model, the Oesophagogastric POSSUM (O-POSSUM) was developed to address esophageal and gastric surgery.[2] The O-POSSUM model was derived from more than 500 patients undergoing esophageal resections, a majority of which were for malignancy. The O-POSSUM model included the POSSUM physiologic score, cancer stage, urgency of the operation, and type of operation performed. The O-POSSUM score, although cumbersome to calculate, predicted 30-day mortality with an observed-to-expected ratio of 1.03 in the single-level model.[2] This scoring system did not include patients who died in-hospital but after the 30-day time point. Further extending risk stratification by looking at 90-day morbidity and mortality may provide more insight regarding the accuracy of predictive models or other variables that affect long-term outcomes. In a study by Talsma and colleagues[3] looking at the differences in 30-day versus 90-day mortality, there was an increase in mortality from 2.7% to 7% over this time period. Many of these deaths were associated with postoperative complications. Extending follow-up to 1 year, because the 30-day and 90-day benchmarks are not based on statistical endpoints, did not capture many additional operative deaths. Instead, mortality that occurred beyond 90 days was due largely to cancer recurrence rather than immediate complications from the initial operation.[3]

Surgical outcomes are assessed with measurable surrogates, such as length of hospitalization, morbidity, and mortality. Factors in the preoperative, operative, and postoperative periods contribute to the length of hospital stay. It is well established that prolonged hospital length of stay after esophageal cancer resection has been linked to increased morbidity, mortality and resource utilization. Using the National Surgery Quality Improvement Program database, Park and colleagues[4] looked at 3538 esophageal resections and found a median length of hospital stay for all patients of 11 days. The following sections address the factors in preoperative, operative, and postoperative periods that have been shown to affect this length of hospital stay.

Preoperative and Operative Risk

Accurate prognostic models would enhance preoperative risk adjustment and even risk modification but such models have been the most challenging to define. Raymond and colleagues[5] recently published an updated risk model of perioperative morbidity and mortality after esophagectomy for esophageal cancer. This risk assessment is based on more than 4000 patients identified from the Society of Thoracic Surgeons (STS) General Thoracic Surgery Database. The overall perioperative mortality after esophagectomy in this database was 3.1%. With this data set, independent predictors of postoperative morbidity and mortality included age greater than 65 years, the presence of congestive heart failure, Zubrod score greater than 1, past or current smoking status, body mass index greater than 35, squamous histology, and McKeown (or 3-hole) esophagectomy.[5] Other studies also confirm that the procedure associated with the highest rate of prolonged hospitalization is a total esophagectomy with thoracotomy.[4]

Park and colleagues[4] found only 2 independent preoperative predictors of prolonged hospitalization: emergency surgery and modified frailty index. Additionally, Ferguson and Durkin[6] identified 3 preoperative factors that were associated with an increased risk of pulmonary complications: age, spirometry values, and performance status. Other factors identified in the preoperative period to predict those who will have pulmonary complications include history of smoking, cirrhosis, and diabetes.[7–9]

Postoperative Complications

Postoperatively, patients with complications have a longer length of hospital stay. The most common and serious complications after esophageal resection are pulmonary complications. Pulmonary complications occur in more than 20% of patients after esophageal resection.[6,10,11] Law and colleagues[11] found that pulmonary complications were responsible for 55% of hospital deaths after esophageal resection for cancer. In this same study, they identified advanced age, tumor location above the tracheal bifurcation, and operation duration as independent risk factors for pulmonary complications.[11] Other factors independently associated with postoperative pulmonary complications included decreased preoperative pulmonary function test, poor performance status, history of smoking, cirrhosis, and diabetes.[6,7]

Anastomotic leak and renal insufficiency have the highest likelihood of prolonging hospitalization.[4] In addition to a longer length of hospital stay, complications, specifically including anastomotic leak, are associated with increased hospital cost and decreased survival.[12,13] The complications that have been associated with the highest hospital cost are chylothorax requiring reoperation and respiratory failure requiring reintubation.[6] There has been no consistently reported