Anesthetic Management for Esophagectomy

Randal S. Blank, M.D., Ph.D
Associate Professor of Anesthesiology
University of Virginia Health System
Charlottesville, VA

DISCLOSURES: None

OBJECTIVES:
At the conclusion of this lecture the attendee will be able to:

1. Understand the pathophysiologic implications of transthoracic esophagectomy surgery and risk factors for perioperative complications.
2. Develop a rational approach to anesthetic management of esophagectomy patients in order to optimize perioperative outcomes.
INTRODUCTION

Esophagectomy is most frequently performed for the treatment of esophageal cancer without local invasion or metastasis \(^1\) and high grade dysplasia \(^2\), but is also used to treat a variety of non-malignant conditions including stricture, severe recurrent gastro-esophageal reflux disease \(^,\) and achalasia \(^3\). Squamous cell carcinoma accounts for the vast majority of esophageal cancers worldwide. However, the incidence of adenocarcinoma has risen sharply throughout the Western world, and now accounts for nearly half of esophageal cancers in many countries \(^4\). In the US, the overall incidence of adenocarcinoma of the esophagus has increased approximately 4 fold from 1973 to 2002.

Esophagectomy surgery can be performed via a transhiatal approach by laparotomy, a two incision surgery utilizing both laparotomy and right thoracotomy (Ivor Lewis), a three incision approach (McKewin) which also requires a cervical incision for anastomosis, and minimally invasive approaches utilizing laparoscopy and/or thoracoscopy. This discussion will focus primarily on anesthetic considerations for transthoracic esophagectomy.

Transthoracic esophagectomy is a technically challenging surgical procedure which has been fraught with a high rate of serious morbidity and mortality. Overall mortality has declined over the past 70 years from >70% pre-1940 to current rates which average approximately 6%, but range from 3-15% in current series. Morbidity remains high with complication rates as high as 40-50%. The frequency and severity of complications after esophagectomy is likely multifactorial and is often thought of in terms of patient and procedural risk factors. These include the older age of the average esophagectomy patient (mean age in US is 62), the frequency of significant comorbidities, the prolonged nature of the surgery itself - involving multiple body cavities- and a number of anesthetic risks including aspiration pneumonitis, ventilator induced lung injury associated with mechanical ventilation and one lung ventilation in particular.

Pulmonary complications represent the most frequent serious morbidity. Anastomotic complications including dehiscence, necrosis, and leak have been considered the most common surgical complication. This discussion will focus on perioperative risks for pulmonary and anastomotic complications after esophagectomy and anesthetic and perioperative approaches to improving outcomes.

PULMONARY COMPLICATIONS

Patients in need of esophageal surgery are generally considered to be at elevated risk of aspiration and its sequelae and rapid sequence induction techniques are widely used and advocated \(^5\). Those patients with severe gastroesophageal pathology, particularly those with obstructive disease and dysmotility syndromes may represent high risk subgroups but clear risk
stratification is lacking. A head up or reverse Trendelenberg position may reduce the passive reflux of gastric contents and aspiration risk \( ^6 \). Intraoperative aspiration is also possible and may be reduced by lubrication of the endotracheal tube cuff \( ^7 \). Placement of a nasogastric tube intraoperatively is essential for postoperative decompression of the esophageal replacement conduit and should be suctioned prior to tracheal extubation.

A prominent feature of esophagectomy surgery which may help explain the high risk of organ dysfunction postoperatively is the profound nature of the immune response. Surgery in general is associated with an activation of systemic inflammatory mediators including macrophages, granulocytes, inflammatory cytokines, neutrophil elastase and others. There is an emerging body of evidence which implicates this response in organ dysfunction after severe inflammatory stressors such as trauma, sepsis and major surgery. It is reasonable to hypothesize that the high degree of morbidity, particularly pulmonary morbidity, associated with transthoracic esophagectomy might be related to an exaggerated inflammatory response. Limited studies comparing the nature and magnitude of such responses to different surgeries have demonstrated the dramatic and profound degree of inflammation associated with esophagectomy as compared to other gastrointestinal and thoracic procedures \( ^8,^9 \). Cytokine levels are elevated in plasma, the thoracic and abdominal cavities, and in the lungs themselves \( ^8-^10 \).

If the profound inflammatory response to esophagectomy is related to pulmonary complications, one might anticipate 1) a correlation between the magnitude of the response and adverse pulmonary outcomes and 2) a potentially therapeutic effect of immunomodulation. These relationships and results of attempts at immunomodulation by anesthetic factors and specific therapeutics will be discussed.

**ANASTOMOTIC LEAK**

The development of an esophageal anastomotic leak is a frequent and serious complication of esophagectomy. This complication is particularly worrisome when the leak is mediastinal in location. Mortality rates from intrathoracic leaks range from 3.3\% to 71\% \( ^{11} \). Preoperative, operative, and postoperative factors that may predispose to the development of anastomotic leak include co-morbidities, surgical and technical factors, and postoperative factors including gastric distension, prolonged ventilatory support and hypoxia. Though still considered a surgical complication, accumulating evidence suggests that intraoperative management may have an impact on the incidence of this complication. Because of the tenuous blood supply to the mobilized gastric tube, fluid status, hemodynamics, and oxygenation may affect anastomotic integrity through effects on oxygen delivery \( ^{12},^{13} \) and blood flow \( ^{12} \). Though the optimization of tissue oxygen delivery through appropriate management of hemodynamics, fluid status, and oxygenation is a priority for all perioperative
patients, this truism may be particularly critical for patients undergoing esophageal anastomoses.

The relatively recent advent of technologies such as laser Doppler flowmetry have permitted the examination and study of gastric tube and anastomotic blood flow and provided important information about impact of perioperative management strategies on tissue blood flow in this critical region.

The use of thoracic epidural analgesia (TEA) has been associated with a decreased risk of anastomotic leak in a retrospective study of esophagectomy patients 14. A causative role is implied by animal experiments in which the use of TEA improved microcirculation and motility in the gastric tube 15 and a clinical study with similar findings 16. For these reasons and evidence of superior pain control, TEA represents the standard of care for transthoracic esophagectomy in most institutions.

Fluid requirements vary widely between patients and procedures and ultimately represent the sum of preoperative deficits, maintenance requirements, and ongoing losses. Despite many studies in the area of perioperative fluid balance and fluid therapy, a consensus of best practice does not yet exist. Excessive perioperative intravenous fluid administration, particularly crystalloid, may contribute to fluid shifting to the interstitial space, potentially increasing complications associated with poor wound healing, slower return of GI function, impaired anastomotic healing, pneumonia and respiratory failure 17.

Goal directed fluid therapies (GDFT) are designed to achieve individualized and specific flow-related hemodynamic endpoints such as stroke volume, cardiac output, or measures of fluid responsiveness such as stroke volume variation and may provide a superior alternative to fixed regimens or those based on static measures of cardiac filling 18. Goal directed colloid but not crystalloid fluid therapy improved microcirculatory blood flow in a porcine model of anastomotic colon 19 and increased tissue oxygen tension in patients undergoing abdominal surgery 20. This finding may be of particular relevance to esophageal surgery where anastomotic integrity may be related to blood flow and oxygen delivery to a potentially flow-compromised esophago-gastric anastomosis.

Some esophageal surgeons eschew the use of vasoconstricting agents for fear of the theoretical adverse effects on gastric tube blood flow, though the limited available data do not support this reasoning. The effect of vasoconstrictors on gastric tube blood flow has not been well studied, but a small clinical study by Al-Rawi and colleagues demonstrated that a TEA-induced sympathectomy decreased gastric tube blood flow during esophagectomy and that epinephrine restored blood flow 21. The use of norepinephrine to maintain arterial blood pressure during esophagectomy as part of a multimodal anesthetic regimen has been associated with reduced respiratory morbidity without
increasing the incidence of anastomotic complications\textsuperscript{22}. Given the established relationship between gastric tube blood flow and anastomotic leak\textsuperscript{12}, maintenance of normal hemodynamics should be a priority in the intraoperative management of these patients.

Future improvements in perioperative outcomes from esophagectomy surgery are likely to result from studies which 1) better define the pathophysiology and mediators of the systemic and pulmonary inflammatory responses, 2) identify potential therapeutic targets, 3) identify hemodynamic goals which lead to optimal tissue perfusion and oxygen delivery (and the means to achieve them), 4) lead to improvements in surgical technique, 5) define anesthetic and perioperative management regimens which minimize iatrogenic lung injury and 6) identify specific therapeutic modalities to augment anastomotic and wound repair.


