

Management of Conduit Necrosis Following Esophagectomy



Karen J. Dickinson, MBBS, BSc, MD, FRCS,
Shanda H. Blackmon, MD, MPH*

KEYWORDS

• Esophagectomy • Conduit • Complication • Necrosis • Reconstruction

KEY POINTS

- Prevention of conduit ischemia or necrosis is better than conduit loss and esophageal diversion.
- Intraoperative assessment of conduit ischemia by the surgeon clinically is poor; specialized techniques, for example, Doppler fluorescence, may be useful.
- Intraoperative suspicion of conduit ischemia should always be acted on, and an alternative conduit may be necessary.
- Primary esophageal defunctioning may be necessary for intraoperative graft necrosis (with venting gastrostomy and feeding jejunostomy).
- Vigilance is required to detect postoperative gastric conduit necrosis as clinical signs may be nonspecific.

INTRODUCTION

Restoration of intestinal continuity following esophagectomy for benign and malignant conditions can be performed using gastric, jejunal, and colonic conduits. In most cases, the stomach is used for reconstruction with other grafts held in reserve. Conduit necrosis is a devastating complication of esophagectomy. Fortunately, this is rare and is only reported in less than 2% of primary resections with reconstruction.^{1,2} The first strategy should be prevention; the authors discuss identification of high-risk patients, operative techniques used to improve conduit vascularity, and methods for the intraoperative and postoperative monitoring of vascularity of these intestinal grafts. The authors discuss strategies to deal with intraoperative conduit ischemia and necrosis. Early identification of this serious complication is key to achieving a good outcome for patients; identification of suspicious clinical signs,

investigation of potential conduit necrosis, and timely management are crucial. A multidisciplinary approach is key to the management of these patients. The role of the thoracic surgeon is complimented by the critical care team, gastroenterologists, dieticians, microbiologists, and, in some cases, plastic surgeons. The authors also discuss the options and challenges of delayed reconstruction after conduit loss.

DEFINITION AND CONSEQUENCES

Definition

Conduit necrosis after esophagectomy is defined as death of the conduit used for reconstruction of the esophagus. The necrotic organ may be stomach, jejunum (pedicled or free graft, with or without supercharging), or colon (with or without supercharging). Conduit ischemia after esophagectomy is defined as inadequate blood supply to the conduit used for reconstruction of the

Disclosure for Financial Support: No disclosures.

Department of Thoracic Surgery, Mayo Clinic, MA-12-00-1, 200 First Street, Rochester, MN 55905, USA

* Corresponding author.

E-mail address: Blackmon.shanda@mayo.edu

Thorac Surg Clin 25 (2015) 461–470

<http://dx.doi.org/10.1016/j.thorsurg.2015.07.008>

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esophagus. An ischemic conduit may progress to necrosis and may present early in the postoperative course with an anastomotic leak or weeks to months after surgery with a stricture.

Consequences

The consequences of conduit necrosis are grave, both for the patients in terms of potential mortality but also in terms of quality of life. Mortality after conduit necrosis can exceed 90%.³⁻⁶ Focal necrosis of the conduit is most likely to occur in the region of the anastomosis, as this has the most tenuous blood supply. It is essential that any gastrointestinal anastomosis should be created without tension and with a good blood supply. Focal ischemia of the anastomosis is, therefore, likely to cause an anastomotic leak. Anastomotic leaks occur in around 10% of esophagectomies nationally⁷ and can be graded from I to IV (grade I, radiological leak only; grade II, minor contained leak; grade III, major leak with evidence of sepsis; grade IV, conduit necrosis).^{8,9} Leaks without significant clinical sequelae can be managed conservatively or endoscopically, for example, with a covered stent and endoscopically sutured in place to prevent migration.^{10,11} Necrosis of the entire conduit or a large section will require reoperation for resection and an end esophagostomy for diversion, in combination with a venting gastrostomy (where applicable), drainage of collections, and feeding jejunostomy. The patients' clinical status must then be optimized before reconstruction can be considered.¹²⁻¹⁴ The consequences for patients are significant. Although an end esophagostomy on the chest rather than the neck can be hidden under clothes and patients will still be able to eat, there is no denying the physical and psychological effects of being dependent on jejunostomy feeding and the anticipation of further major surgery for reconstruction.

A late consequence of conduit ischemia is the development of a stricture, either in the conduit itself or at the anastomosis. Conduit ischemia, anastomotic leak, and stricture are intertwined clinical entities.¹⁵ Strictures will present with dysphagic symptoms and will affect patients' quality of life. Multiple dilatations will often be required in these patients.

PREVENTION

Preoperative: Individual Risk Assessment

Of key importance to the management of conduit necrosis is the identification of risk factors and high-risk patients. Preoperative and intraoperative strategies can be used to optimize patients, their anatomy, and physiology. In some cases the risks

of conduit necrosis and morbidity/mortality from surgery will be prohibitive, and patients and families should be counseled accordingly. Patients with significant comorbidity have been shown to have an odds ratio (OR) of 2.2 (1.1-4.3, $P = .023$) for the development of conduit ischemia.¹⁵ Additionally, conduit ischemia was associated with an OR of 5.5 (2.5-12.10) for anastomotic leak and 4.4 (2.0-9.6) for stricture development.¹⁵ Patient factors, such as smoking, neoadjuvant therapy, and preoperative weight, were not, however, associated with increased ischemia. Intuitively, when contemplating esophageal reconstruction, the authors are concerned about patients with diabetes, hypertension, and peripheral arterial disease. In comorbid patients a strategy to deal with this is to perform delayed conduit formation. Of the 37 patients in whom this was used, 6 had diabetes, 18 hypertension, 16 coronary artery disease, 10 were obese (body mass index >30), and 2 had undergone previous pneumonectomy.¹⁶ Preoperative risk assessment of any patient undergoing esophageal resection is essential and should include a full history and examination including assessment of cardiorespiratory function (ie, supervised exercise in clinic, cardiopulmonary exercise testing, pulmonary function testing, echocardiography, coronary angiography where indicated). For hypertensive patients control should be assessed and end organ damage identified, for diabetic patients assessment of diabetic control is critical (hemoglobin A_{1c}) and, in the presence of previous abdominal surgery or where colonic interposition is considered mesenteric angiography should be performed.

Intraoperative: Ischemic Preconditioning, Assessment of Conduit, Blood Pressure Support

Ischemic preconditioning

Ischemic preconditioning of the gastric conduit before esophageal reconstruction has been proposed in an attempt to reduce conduit necrosis and anastomotic leak rates. Urschel and colleagues^{17,18} first described this in 1997. Subsequently Schröder and colleagues^{19,20} demonstrated that the gastric conduit microcirculation takes 4 days to return to preoperative levels after esophagectomy. The mechanism of effect is unclear, but neovascularization of the stomach and release of humoral factors to improve the blood supply to the fundal area have both been proposed. The basis for this concern is related to studies in cadaveric specimens after esophagectomy in which it has been shown that 20% of the blood flow to the top of the gastric conduit is

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