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Esophageal replacement

Shaun M. Kunisaki, MD, MSc*, Arnold G. Coran, MD

Section of Pediatric Surgery, Department of Surgery, C.S. Mott Children's Hospital, University of Michigan Medical School, 1540 E. Hospital Dr, SPC 4211, Ann Arbor, Michigan

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ABSTRACT

This article focuses on esophageal replacement as a surgical option for pediatric patients with end-stage esophageal disease. While it is obvious that the patient's own esophagus is the best esophagus, persisting with attempts to retain a native esophagus with no function and at all costs are futile and usually detrimental to the overall well-being of the child. In such cases, the esophagus should be abandoned, and the appropriate esophageal replacement is chosen for definitive reconstruction. We review the various types of conduits used for esophageal replacement and discuss the unique advantages and disadvantages that are relevant for clinical decision-making.

The need to replace the esophagus in children is becoming increasingly rare. Nevertheless, there continue to be situations where esophageal replacement is the best surgical option for the patient, and it is important for the pediatric surgeon to be familiar with the various options available for this complex undertaking.

Indications for esophageal replacement

Esophageal atresia

Infants with long-gap esophageal atresia (EA), usually Gross type A or B, constitute the main group of pediatric patients who require esophageal replacement. In these patients, the gap between the proximal and the distal esophagus may preclude the ability to achieve an end-to-end anastomosis. Numerous maneuvers have been described to obtain a primary anastomosis in EA, thereby allowing retention of the infant's native esophagus.[1–16] A list of these techniques is summarized in Table 1.

In long-gap patients, it is imperative to perform an accurate gap study, preferably by placing a neonatal endoscope through the gastrostomy and into the end of the distal esophageal remnant.[17,18] When the gap between the proximal and the distal esophagus measures between three and eight vertebral bodies, or if at thoracotomy an anastomosis cannot be achieved even under extreme tension, delayed primary repair after a trial of spontaneous growth should be attempted. It is now widely accepted that spontaneous growth of the esophageal pouches (approximately 50% gap reduction at 12 weeks) occurs in most infants.[12] These patients should receive bolus feeds by gastrostomy, and a bronchoscopy should be performed to rule out a proximal tracheoesophageal fistula (TEF), an underappreciated entity that may be seen in approximately 5% of all cases.[19] In experienced hands, consideration can also be given to various internal and external traction techniques (e.g., Foker maneuver) to help facilitate an eventual delayed primary repair over a shorter time span (1–4 weeks).[15,20,21]

Although it is obvious that the patient's own esophagus is the best esophagus, persisting with attempts to retain the native esophagus in the presence of major complications (e.g., empyema, intractable stricture, and repeated recurrent fistulas) at all costs is futile and is usually detrimental to the well-being of the infant. When there is only a small nubbin of distal esophagus above the hiatus, or when no intrathoracic esophagus at all, it is clearly in the patient's best interest and safety to abandon the esophagus and perform a replacement procedure. If clinical circumstances do not permit for a definitive esophageal reconstruction or replacement intraoperatively, then a cervical esophagostomy should be performed with a replacement procedure done at a later date. This will allow the infant to go home pending a later replacement procedure. The infant is now free from the danger of aspiration, and appropriate bonding with the family can take place at home.

Peptic strictures

Because of the greater awareness of the irreversible damage that can occur as a consequence of severe, uncontrolled gastroesophageal reflux disease (GERD), aggressive approaches in GERD management using proton pump inhibitors, anti-reflux surgery,

* Corresponding author.
E-mail address: shaunkun@umich.edu (S.M. Kunisaki).

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Table 1
Surgical maneuvers in long-gap esophageal atresia.

During the initial procedure
Anastomosis under tension
Tension-relieving procedures
Flap technique
Suture fistula
Delayed primary anastomosis
Bouginenage and/or magnets
Without bougienage
Gastric division
Traction sutures (e.g., Foker process)
Transmediastinal "thread"
With or without olives
Kato technique
Esophageal replacement
Gastric transposition
Gastric tube esophagoplasty
Colonic interposition
Jejunal interposition

and postoperative endoscopic dilations have led to a dramatic decrease in peptic strictures as an indication for esophageal replacement.[22] Furthermore, a small percentage of patients with severe esophageal strictures may avoid esophageal replacement by performing a limited "sleeve" resection of a focal stricture.

Caustic strictures

Children continue to sustain caustic esophageal injuries requiring esophageal replacement. However, with the introduction of legislation mandating childproof containers for caustic substances in the 1970s, fewer lye and caustic injuries to the esophagus are now seen in the United States and other developed countries.[23] In severe cases, there is full-thickness injury to more than a short segment of the esophagus, which invariably results in an intractable stricture that can fail to respond to dilations. We have found that continuing with dilatations at frequent intervals for longer than 6–12 months is usually unproductive. Temporary esophageal stenting can be helpful as definitive therapy, but its precise role remains undefined.[24] Moreover, the long-term risk of malignancy and the ease with which esophagectomy can be performed in children tend to favor resection and substitution.

Miscellaneous indications

The need for an esophageal replacement because of bleeding esophageal varices is virtually obsolete as a result of the success of alternative techniques, particularly sclerotherapy, banding, and portosystemic shunts. Tumors of the esophagus can sometimes require resection of extensive lengths of the esophagus. Examples of such rare tumors in children are diffuse esophageal leiomyomatosis and inflammatory pseudotumor. The esophagus may be extensively damaged by prolonged impaction of foreign bodies such as aluminum can ring pulltops that are radiolucent and therefore may escape detection on conventional radiography. Other unusual indications for esophageal replacement include intractable achalasia, diffuse candidiasis in children with immune deficiency, scleroderma, epidermolysis bullosa, and human immunodeficiency virus strictures.[9,25,26]

General considerations for esophageal replacement

Comprehensive reviews on the history of esophageal replacement in children have been documented by others.[27,28] The current methods commonly used are illustrated in Figure 1. The advantages and disadvantages of these procedures are delineated

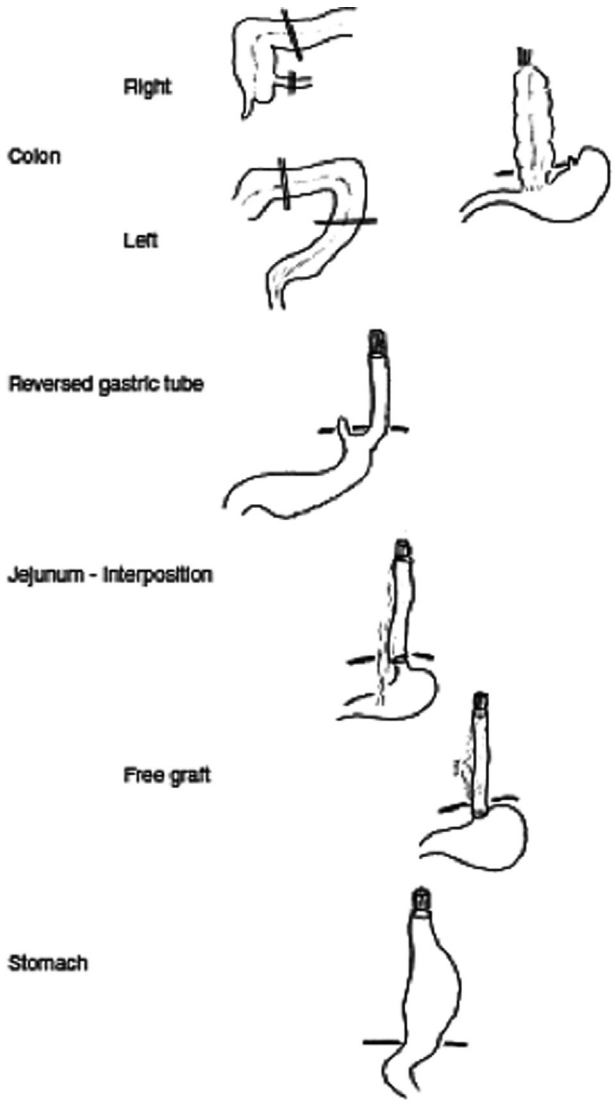

Fig. 1. Major types of conduits used for esophageal replacement.

in Table 2. Because there have been no randomized controlled trials of esophageal replacement in children,[29] the conduit chosen by the surgeon is often highly dependent on his or her training/experience with one particular technique. Although several synthetic and biosynthetic prostheses using innovative tissue engineering technologies have been tried experimentally as substitutes for the esophagus, vascularization continues to be a major barrier toward clinical translation. Moreover, the function of these materials remains poor, and long-term data are virtually nonexistent.[30–33]

The characteristics of the ideal esophageal substitute are listed below as follows[34]:

- The operative technique should be technically straightforward, reproducible, and adaptable to small children.
- The substitute must function as an efficient conduit from the hypopharynx to the stomach to satisfy the nutritional needs of the child.
- Gastric acid reflux into the conduit must be minimal, and if reflux does occur, the substitute should be resistant to gastric acid.
- The substitute should not cause mediastinal compression, thereby impairing cardiopulmonary function.