Steven L. Gans Distinguished Overseas Lecture

Esophageal replacement: Overcoming the need

Lewis Spitz
Institute of Child Health, University College, London
Great Ormond Street Hospital for Children NHS Trust, London WC1N 3JH UK

Abstract

Article history:
Received 10 January 2014
Accepted 27 January 2014

Key words:
Esophageal replacement
Gastric transposition
Colon interposition
Gastroesophageal reflux

Three developments which have contributed to the declining necessity for esophageal replacement are improvement in the management of esophageal atresia, prevention of caustic injuries to the esophagus, and early antireflux surgery for intractable gastro-esophageal reflux. Despite these advances, replacement of the esophagus may still be necessary. The two most commonly used procedures for replacing the esophagus are colonic interposition and gastric transposition. Experience with 236 gastric transposition operations reveals a mortality of 2.5%, leak rate of 12%, and stricture of 20%. The follow-up shows a satisfaction of over 90%. New methods of overcoming the need for esophageal replacement are in progress with tissue engineering with a scaffold to produce a tubular graft to bridge the gap in the continuity of the esophagus.

© 2014 Published by Elsevier Inc.
2. Caustic esophageal damage

Injury to the mucosal surface occurs within seconds of the ingestion of the strong alkali. The liquifaction necrosis rapidly extends through the epithelial layer and submucosa and may extend into and through the muscle layer. The ultimate outcome in severe cases is extensive stricture formation. The provision of child proof containers of caustic soda has had a major preventative effect in developed countries, whereas in the developing world, particularly in rural areas where caustic agents are used extensively for soap making and drying fruit, and where cleaning material is stored in unsuitable containers, caustic injuries continue to be a major health hazard [4]. The prevalence of caustic injuries among children in the United States is estimated to be 1.08 per 100,000 population. The number of hospitalizations is down from 5000–15,000 per year in the 1980’s to 807 in 2009[5]. Early esophagoscopy is important to confirm the ingestion and to assess the severity of the damage. The continuing need for regular dilatation 6–12 months following the injury constitutes an indication for esophageal resection and replacement.

3. Reflux strictures

Early antireflux surgery of severe pathological gastro-esophageal reflux will prevent intractable strictures from developing. It is particularly in the severely neurologically disabled child that symptoms of reflux are ascribed to the developmental delay while irreversible strictures occur. Most cases of severely strictured and inflamed esophagus will resolve following fundoplication and regular postoperative dilatations. A small minority will eventually require esophageal replacement [6].

4. Other indications for esophageal replacement

Other indications for esophageal replacement include tumors of the esophagus, such as diffuse leiomyoma or inflammatory pseudo-tumor or rarely carcinoma, prolonged impaction of foreign bodies, such as aluminum ring can tops [7], which are radiolucent and may escape detection for prolonged periods, and button batteries causing wide tracheoesophageal fistula, intractable achalasia, epidermolysis, and human immunodeficiency (HIV) strictures [8].

5. Esophageal replacement

The four most commonly used methods of esophageal replacement are

1. colonic interposition
2. reversed gastric tube
3. jejunal interposition
4. gastric transposition

Each method has its own problems and complications, but in our experience the gastric transposition is associated with the lowest complication rate and is the least complicated procedure. 

Colon interposition has a precarious blood supply, usually arising from the ascending branch of the left colic artery. It is complicated by a

![Diagram of the technique of gastric transposition](image)

**Fig. 1.** Illustration of the technique of gastric transposition. (a) Closure of gastrostomy. (b) Closure of gastro-esophageal junction. (c) Pyloroplasty/myotomy. (d) Sutures of top of fundus of stomach. (e) Esophago-gastric anastomosis. (f) Transposed stomach. (g) Pyloroplasty below hiatus. (h) Jejunal feeding tube.
transposition, giving a procedure related mortality of 2.5%.

Gastric tube esophagoplasty involves a very extensive suture line with a high incidence of leaks and strictures. There is also the problem of Barrett’s esophagitis developing from acid reflux into the cervical stumps.

Jejunal interposition is favored by some, but the blood supply is precarious, although the interposed jejunal segment is of appropriate calibre and is reputed to retain peristaltic activity.

Gastric transposition involves transposing the whole stomach into the cervical region. The blood supply of the stomach is excellent, length is not a problem, and the procedure is relatively straightforward. The anastomotic leak rate is low and most close spontaneously, but strictures occur in 20% of cases with the highest incidence in replacement for caustic injury (58%). Reflux, dumping, and poor gastric emptying are problems mainly in the short-term, and Barrett’s esophagitis may develop long-term.

6. Surgical technique for gastric transposition (Fig. 1) [9,10]

The preferred route for gastric transposition is a transhiatal retromediastinal approach without thoracotomy. The procedure has been performed laparoscopically with good results [11]. The stomach is fully mobilized, dividing the left gastric and left gastro-epiploic vessels, and a pyloroplasty or myotomy is performed. The highest point on the mobilized stomach is the top of the fundus, which is marked with two different sutures to prevent rotation during transfer through the mediastinum. The stomach is passed via the hiatus through the retromediastinum into the neck, where it is anastomosed to the cervical esophageal stump. A trans-gastric or jejunal feeding tube is placed for temporary enteral feeding in children who have never taken nutrition orally. Postoperatively, elective paralysis and ventilation are used for a few days.

7. Results [12]

The surgical team at Great Ormond Street Hospital (GOS), London, has performed a total of 236 gastric transposition procedures since 1980. There were 147 male and 89 female patients. The primary condition afflicting the infants were esophageal atresia in 177 cases, of which 95 were atresia with distal tracheoesophageal fistula, 65 isolated atresia, 15 atresia with proximal fistula, and two H-fistula. In addition, 32 had extensive stricture following caustic ingestion, and 9 suffered intractable gastroesophageal reflux strictures. The remaining 16 patients included congenital stricture (4), achalasia, diffuse leiomyomatosis, and prolonged foreign body impaction (2 each, respectively). Eighty-one percent of cases were isolated atresia, 15 atresia with proximal tracheoesophageal fistula, and 2 H-fistula, of which 19 involved colon, 5 partial gastric replacement, 3 each Scharli procedures and gastric tube esophagoplasty, and one attempt at the Foker procedure.

The route for the replacement was via the posterior mediastinum without thoracotomy in 109 cases, transthoracic in 95 cases due to extensive scarring from previous surgery, retrosternal in 7, and recently laparoscopically in 25 cases, of which 8 needed to be converted to open approach due to dense adhesions. A pyloroplasty or myotomy was performed according to surgeon preference. All patients were electively ventilated postoperatively except for the first 4 cases.

Eleven patients died, 5 from conditions unrelated to the gastric transposition, giving a procedure related mortality of 2.5%. Anastomotic leaks occurred in 28 patients (12%) and strictures in 48 cases (20%), of which 17 were secondary to caustic scarring. Swallowing problems postoperatively were almost universal, but in 55 (29%) patients it was significant, moderate in 26, and severe in 29 cases. Delayed gastric emptying was a problem in 21 (8.8%) cases in some patients necessitating conversion of pyloromyotomy to plastic or more radically to gastrojuenostomy. Eight patients developed problematic dumping syndrome which eventually resolved and 4 others a Horner’s syndrome which also eventually resolved. A late complication encountered in 6 patients was herniation of small intestine into the chest via the esophageal hiatus. This complication was eliminated by narrowing the hiatus and suturing the end of the hiatus to the antrum of the stomach.

Follow-up showed that weight generally was in the lower centiles for age, while height was normally distributed. Overall, more than 90% of patients were highly satisfied with the procedure, and there did not appear to be any deterioration in functioning of the transposed stomach in the long-term.

8. Conclusion

Significant progress has been made in recent years to reduce the need for esophageal replacement. These include improved management of esophageal atresia, prevention of caustic injury by child proof containers, and earlier surgery for intractable gastroesophageal reflux, particularly in the neurologically impaired child.

Despite these advances, there are occasions when the esophagus needs to be replaced. Of the two most commonly used methods of replacement, gastric transposition is favored because of the excellent blood supply of the stomach, the ease of the procedure, and lower leak and stricture rates. There is a clear need to centralize the management of the “difficult” esophageal atresia cases as well as for replacing the esophagus to few specialist centers to improve outcomes, enhance expertise, and carry out research.

Progress is being made with tissue engineering in the creation of a tubularized graft of the esophagus which may supercede current methods of replacement [13]. The new esophagus will be comprised of a scaffold of synthetic or natural origin and cells which could be derived from fetal tissue if the diagnosis of pure atresia is suspected prenatally or from bone marrow and mucosa if replacement is required after birth.

Acknowledgments

Thanks are due to Edward Kiely, Agostino Pierro, David Drake, and Joe Curry for allowing inclusion of their patients, to Paolo De Coppi for information on tissue engineering, and to Marcia Matias for collecting the data.

References


