

Gastric Tube Interposition for Esophageal Replacement in Children, Is it the best option?

Ahmad Khaleghnejad Tabari *¹, Mohsen Rouzrokh ¹,

Nasibeh Khaleghnejad-Tabari¹

¹ Pediatric Surgery Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Address for corresponder A. Khaleghnejad Tabari, Pediatric Surgery Research Center, Mofid Childrens Hospital, Shariati Ave. Tehran. IRAN
(e-mail: khalegh@ams.ac.ir)

How to cite this article:

Khaleghnejad Tabari A, Rouzrokh M, Khaleghnejad Tabari N. Gastric Tube Interposition for Esophageal Replacement in Children, Is it the best option?. *Iranian Journal of Pediatric Surgery* 2015; 1(2): 58-62.

Abstract

Introduction: Replacement of esophagus can be accomplished using different parts of the gastrointestinal tract, in various positions and in single and multiple stages. The aim of this study is to present the results of gastric tube interposition in children with congenital esophageal anomalies and severe acquired esophageal stricture.

Material and Methods: This series describes 22 patients who underwent gastric tube interposition procedures for esophageal replacement at Mofid Children's Hospital Tehran, Iran between 1996 and 2014. Clinical data including the indication for esophageal replacement, technique and timing of repair, early and late complications, and long-term follow-up were retrospectively gathered from patients' medical records.

Results: Patients consisted of 17 Male and 5 female, aged 8 months to 14 years (mean 47.8 months). Twenty one patients had normal oral feeding and proper weight gain. The mean time of follow up was 9.25 years (9 months to 18 years). One of our cases developed failure to thrive although he had no difficulty in swallowing and was eventually put on supplementary feeding by gastrostomy. There were 3 strictures: one in the neck anastomosis which was treated by dilatation and revision of anastomosis, one in the hiatal level which was because of tight hiatus and was treated by widening of hiatus. The last patient had a stricture at mid-portion of gastric tube, and was treated by dilatation, which resulted in perforation and was treated by stricturoplasty. Three leaks occurred at the neck anastomosis, two healed spontaneously and one resulted in intra thoracic leak and mediastinitis that led to death after 3 months. Another child with lymphocyte adhesion deficiency died due to infected neck wound and severe bleeding from carotid artery 22 days postoperatively, a third death occurred many years after the original operation due to mediastinitis which was the result of dilatation for stricture formation.

Conclusions: Although gastric tube replacement in posterior mediastinum seems an ideal replacement because of adequate length which makes it easily reachable to pharynx, good blood supplies, straight and proper size; the management of complicated cases such as mediastinal leaks and strictures is very challenging and rules out this method of esophageal replacement as the best option possible.

keywords

- Gastric tube interposition
- esophageal replacement
- esophageal atresia
- caustic injury

Introduction

Surgical reconstruction of the esophagus is performed to maintain the anatomy in children with a variety of congenital and acquired disorders including: severe caustic or peptic esophageal strictures, long gap esophageal atresia and various other infectious and congenital esophageal strictures.¹ There is still debate on the best organ for esophageal replacement.²

Four approaches to esophageal substitution are in use at present³:

- 1) Some form of colon inter position in various position
- 2) Total gastric pull-up through the posterior mediastinum
- 3) Gastric tube interposition in various position
- 4) Substitution with jejunum

Although there are many studies in favor of one substitution^{4,5,6,10,13,15,16,21,22}, there are few studies that indicate there is no difference between the two methods of substitution regarding nutrition, growth, early and late complications, long-term function and patients acceptability.^{2,7}

We have favored the reverse gastric tube interposition as a procedure of choice in our institution and lodge the substitution at the posterior mediastinum after resection of native strictured esophagus. The results of this modified gastric tube technique are the subject of this study.

Material and Methods

Between 1996 and 2014, 22 gastric tube interposition procedures were performed for esophageal replacement at Mofid Children Hospital Tehran, Iran. The indication for esophageal replacement was severe stricture secondary to caustic ingestion in 13 patients, gastroesophageal reflux (GER) stricture in 4 patients, long gap esophageal atresia in 3 patients, multiple esophageal stenoses in one and stricture in the esophagus due to monilia in one lymphocyte adhesion deficiency case. In 5 patients, 4 of which had peptic stricture due to GERD and one with stricture due to caustic injury of the esophagus, the stricture was in distal one third of the esophagus and had laparotomy and gastric tube formation first, followed by right thoracotomy and partial esophagectomy and intra- thoracic anastomosis. In 3 esophageal atresia patients in which one had pure

atresia without fistula and one had experienced a failed primary anastomosis, gastric tube was made first and pulled up to the neck for anastomosis through a transhiatal approach.

One alkaline caustic stricture patient who suffered from perforation as a complication of the dilatation course underwent right thoracotomy for esophageal resection and neck esophagostomy. Three months later he was operated on for gastric tube formation and neck anastomosis through a transhiatal approach.

In the remaining 13 cases, first a total esophagectomy was carried out with right thoracotomy, then gastric tube formation and neck anastomosis was performed at one stage.

Reverse gastric tube was made around a size 18-24 chest tube according to the size of the patients, using only the left gastro epiploic artery. The neoesophagus (gastric tube) was positioned in the anatomic place of the native esophagus at the posterior mediastinum.

The tube was made manually or by stapler and the first absorbable suture line was reinforced by a 4.0 silk. Neck anastomosis was performed by 4.0 silk. Pyloroplasty and transpyloric feeding tube was placed in all patients. Contrast study was carried out at 7 to 10 postoperative days.

Routine follow up including symptoms, growth and toleration of diet was performed by regular clinical exam and contrast study and endoscopy.

Results

The demographic data of our cases are summarized in **Table 1**. Nineteen of 22 children are presently alive 9 months to 18 years postoperatively and 18 (81.81%) of them are well and tolerating oral diet and have normal growth and development.

Table 1: Demographic characteristics of patients

characteristics	Number	Range
Male	17	
Female	5	
Mean age at operation (month)	47.8	(13 months-14 years)
Mean time of followup (year)	9.25	(9 months-18 years)

In one of our cases (a case of esophageal atresia) growth retardation developed 1.5 years after operation without any difficulties in swallowing and the neo-esophagus was evaluated several times by contrast study and endoscopy and the patient was put on supplemental feeding by gastrostomy and gradually improved but is still below the 50th percentile of the normal growth curve.

Four (18.18%) patients developed a leak at the cervical anastomosis, 3 (13.63%) healed spontaneously within few weeks and one (4.54%) resulted in mediastinitis, intrathoracic leak and had a second operation for esophagostomy and chest drainage. This patient developed severe sepsis and thrombocytopenia and died 3 months after operation. The fourth patient developed mediastinitis and underwent thoracic drainage; after he became stable the gastric tube was resected and colon interposition was carried out instead.

Three (13.63%) patients developed stricture, first stricture was at the neck anastomosis in a multiple congenital stenoses case and after several months of ineffective dilatation underwent two operations for revision of anastomosis and again at the age of 16 years developed a severe stenosis and during dilatations; perforation and mediastinitis occurred and although he underwent thoracotomy and received sepsis management he didn't survive.

The second stricture was at the hiatal level in an esophageal atresia case due to a tight hiatus and after several dilatations underwent operation for widening of hiatus.

The third stricture was at the mid portion of gastric tube and during dilatation developed perforation and underwent operative repair and now is doing well.

There were three (14.2%) mortalities in this study, the first one was in a monilial stricture in a patient with lymphocyte adhesion deficiency, who developed severe neck wound infection and eroding of carotid artery with massive bleeding and died 22 days post operation and the second death was because of leak and mediastinitis and sepsis and thrombocytopenia. The last one was in a 16 year old boy who developed stricture many years after the primary operation and during dilatations; perforation and mediastinitis occurred and ultimately died of sepsis as described earlier. The results are summarized in **Table 2**.

Table 2: Complications and mortality

Complication	Number	Percent
Leak	4	18.18%
Stricture	3	13.63%
Failure To Thrive	1	4.54%
Mortality	3	13.63%

Discussion

The rate of esophageal replacement in the pediatric population has declined over the past three decades with advances in correction of long gap esophageal atresia, earlier diagnosis and proper management of gastro-esophageal reflux and improved package warning and protection with caustic liquid. There are circumstances in which an esophageal replacement is required. Once the decision has been taken to abandon further attempt at reconstruction or when the esophagus has been irretrievably damaged, the choice of ideal substitution remains open to debate.^{10,21} The properties of an ideal esophageal substitute are that its size and function should be comparable with the esophagus especially regarding its peristaltic activity, it should not be too space-occupying in thorax, it should have good blood supply, reflux of gastric content into the substitute esophagus must be minimal or correctable or the mucosa itself must be resistant to gastric juice, and the operative procedure should be relatively simple and straightforward.^{6,8,11,17,21,22}

The four options currently used are: colonic interposition^{2,7,10,13,16}, gastric transposition^{12,18,19}, gastric tube esophagoplasty^{5-8,9,12,14,18,20}, and jejunal interposition²⁰. These substitutes are placed in three routes through the thorax: substernal, left retrohilar and transmediastinal. The advantages and disadvantages of these four procedures have been widely discussed.²¹ The large number of procedures for replacement of the esophagus attests to the lack of a single ideal substitute, in experienced hands all of the methods will support adequate nutrition for a growing child, permitting regular meals with a normal quality of life.^{2,7}

Gastric tube replacement of the esophagus became a practicality in children in early 1970's and gastric tube has quickly become popular because they can be constructed rapidly with a stapling device.^{6,8} The gastric tube can be constructed from antrum up (reverse gastric tube)^{5,6,12,18,20} and from the fundus downwards¹⁰ and can be made with enough length to reach the neck and pharynx.

Gastric tube can be placed substernally or behind of either pulmonary hilum,^{6,8} in a comparison study, functional results of gastric tube were similar, whether they were placed transthoracically or substernally, but there is a chance of tube necrosis when the substernal route is used.⁸ In this study consistent with experiences of other studies^{10,17,20,22} the esophagus was placed at posterior mediastinum where is a shorter root and more anatomic and not space-occupying for thorax.

This route may limit long-term distension, making the substitute more tubular and preventing potential respiratory compromise. Reflux is not a problem if enough length (at least 6 cm) of gastric tube is located within the abdomen.^{6,8} The use of some antireflux procedure (Toupet posterior fundoplication) may control the acid reflux into gastric tube substitute.⁷ It has been considered best to perform esophageal replacement procedures after one year of age, when the volume of stomach is enough to create a gastric tube^{7,8,17} and the children at this age are sitting upright most

of the time and this can act to reduce acid reflux.¹⁷ The other methods to reduce acid reflux are vagotomy and pyloroplasty that are used as a lowering acid procedure.^{8,18,21,22} In this study, pyloroplasty and transpyloric feeding tube insertion were carried out for all patients. Removal of the native esophagus is one of the factors that should be considered in esophageal replacement.^{6,10,11,16} This resection can be done by close and open procedures, but benefit of open procedure for the scarred esophagus with adhesion to the surrounding mediastinal structures has been reported in previous studies.^{6,10} This study described the technical aspects of several procedures, the goal was to achieve total esophagectomy and reverse gastric tube replacement in one stage, with mediastinal positioning of gastric tube. Although the results of immediate and late evaluation are acceptable, but the management of complicated cases such as mediastinal leaks and strictures is very challenging and seems that this method of esophageal replacement is not the very best option.

References

- Burgos L, Barrena S, Andrés A. M, et al: Colonic interposition for esophageal replacement in children remains a good choice: 33-year median follow-up of 65 patients. *Journal of Pediatric Surgery* 2010; 45: 341–345.
- Gallo G, Zwaveling S, Van der Zee D.C, et al: A two-center comparative study of gastric pull-up and jejunal interposition for long gap esophageal atresia. *Journal of Pediatric Surgery* 2015; 50:535–539.
- Spitz L: Esophageal replacement: Overcoming the need. *Journal of Pediatric Surgery* 2014; 49: 849–852.
- Tannuri U, Maksoud-Filho J. G, Tannuri A. C. A, et al: Which is better for esophageal substitution in children, esophagocoloplasty or gastric transposition? A 27-year experience of a single center. *Journal of Pediatric Surgery* 2007; 42: 500– 504.
- Anderson KD, Randolph JG: Gastric tube interposition: a satisfactory alternative to the colon for esophageal replacement in children. *Ann Thorac Surg* 1978; 25(6): 521-5.
- Anderson KD: Gastric tube esophagoplasty. *Prog Pediatr Surg* 1986; 19: 55-61.
- Anderson KD, Noblett H, Belsey R. et al: Long-term follow-up of children with colon and gastric tube interposition for esophageal atresia. *Surgery* 1992; 111(2): 131-6.
- Ashcraft KW. The esophagus. In: Ashcraft KW, Holcomb GW, Murphy JP. *Pediatric surgery*. 4th ed. Philadelphia: Elsevier Saunders, 2005: 330-351.
- Borgnon J, Tounian P, Auber F. et al: Esophageal replacement in children by an isoperistaltic gastric tube: a 12-year experience. *Pediatr Surg Int* 2004; 20(11-12): 829-33.
- Canty TG Sr, LoSasso B.E: One-stage esophagectomy and in situ colon interposition for esophageal replacement in children. *J Pediatr Surg* 1997; 32(2): 334-6.
- Dillon PA. Esophagus. In: Oldham KT, Colombani PM, Foglia RP, Skinner MA. *Principles and practice of pediatric surgery*, Vol 2. Philadelphia: LWW, 2005: 1023-1038.
- Ein SH: Gastric tubes in children with caustic esophageal injury: a 32-year review. *J Pediatr Surg* 1998 Sep; 33(9): 1363-5.
- Han MT. Ileocolic replacement of esophagus in children with esophageal stricture. *J Pediatr Surg* 1991 Jul; 26(7): 755-7
- Heimlich HJ: Reversed gastric tube (RGT) esophagoplasty for failure of colon, jejunum and prosthetic interpositions. *Ann Surg* 1975; 182(2): 154-60.
- Hirschl RB, Yardeni D, Oldham K, et al: Gastric transposition for esophageal replacement in children: experience with 41 consecutive cases with special emphasis on esophageal atresia. *Ann Surg*. 2002; 236(4): 531-9.
- Khan AR, Stiff G, Mohammed AR, et al.: Esophageal replacement with colon in children. *Pediatr Surg Int* 1998; 13(2-3):79-83.
- O’Neil JA. Esophageal stenosis, stricture and replacement. In: O’Neil JA, Grosfeld JL, Fonkalsrud EW, Coran AG, Caldumone

AA. Principles of pediatric surgery. 2nd ed. St. Louis: Mosby 2004: 395-403.

18. Pedersen JC. Klein RL. Andrews DA: Gastric tube as the primary procedure for pure esophageal atresia. *J PediatrSurg* 1996; 31(9):1233-5.

19. Saeki M. Tsuchida Y. Ogata T et al: Long-term results of jejunal replacement of the esophagus. *J PediatrSurg* 1988; 23(5): 483-9.

20. Schettini ST. Pinus J: Gastric-tube esophagoplasty in children. *PediatrSurgInt* 1998; 14(1-2): 144-50.

21. Spitz L: Gastric transposition for esophageal substitution in children. *J PediatrSurg* 1992; 27(2): 252-7.

22. Spitz L, Kiely E, Pierro A: Gastric transposition in children-a 21-year experience. *J PediatrSurg* 2004; 39(3): 276-81.