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☐ Case Report ☐

Transhiatal Gastric Transposition of A Long Gap Esophageal Atresia

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Transhiatal gastric transposition was performed in a long gap esophageal atresia without tracheoesophageal fistula. The patient was a 12 months old female infant with previous stamm-type gastrostomy. The stomach was mobilized preserving the right gastric artery, the right gastroepiploic artery and spleen. The proximal and distal blind pouches of esophagus were excised by transcervical and transhiatal route, respectively. The mobilized stomach was pulled up into the neck through esophageal hiatus and posterior mediastinal route. The esophagogastrostomy, the only one anastomosis of this procedure, was safely performed in the neck. There were neither anastomotic leak nor early anastomotic stricture. The oral feeding was quickly established. There was no clinical evidence of regurgitation, difficulty of gastric emptying, hoarseness or respiratory problem. The low morbidity combined with satisfactory functional result indicates that the transhiatal gastric transposition is a safe and easy alternative surgical procedure for esophageal replacement in long gap esophageal atresia.

Key Words: Esophageal atresia, transhiatal gastric transposition

Most of the infants with an esophageal atresia can be managed by a primary esophagoesophagostomy. But a long gap esophageal atresia gives a challenge to the pediatric surgeon. There were various maneuvers to bridge a long gap between the proximal and distal esophageal segments. The delayed primary anastomosis with or without bougination has been preferred by many pediatric surgeons for a long time. Nervertheless, in a small group of infants with a long gap esophageal atresia, primary anastomosis cannot be safely achieved and an esophageal replacement may be required. Various methods of esophageal substitution have been attempted, including the use of vascularized colon, jejunal interposition, reversed gastric tube, or gastric transposition. The popular methods of the esophageal replacement in pediatric patients have been the colon interpostion and the reversed gastric tube esophagoplasty. However, there are some disadvantages in these two methods.

In adult patients of esophageal cancer, the transhiatal esophagectomy and gastric transposition without thoracotomy have been used successfully in our hospital for a long period of time (Kim CB *et al.* 1991). Although encouraging reports of transhiatal gastric transposition in children have been published in other counturies (Spitz L 1984; Spitz L *et al.* 1987; Spitz L 1992), there has been no report of transhiatal gastric transposition for a long gap esophageal atresia of children in Korea. This paper reports the first successful transhiatal gastric transposition in Korea to replace the esophagus for a long gap esophageal atresia.

CASE AND OPERATIVE METHOD

Case

A 2.4 Kg girl was born by normal vaginal

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delivery with 38 weeks of gestation. After the diagnosis of type A esophageal atresia, gastrostomy had been performed at other hospital. The patient was referred to us for a corrective surgery at the age of 12 months. The contrast study via the gastrostomy demonstrates the short distal blind esophageal pouch (Fig. 1). The proximal blind pouch was located just above the tracheal bifurcation, confirming the diagnosis of a long gap esophageal atresia without a tracheoesophageal fistula.

The esophageal replacement was made by the transhiatal gastric transposition. The bilateral pneumothorax were developed during op-

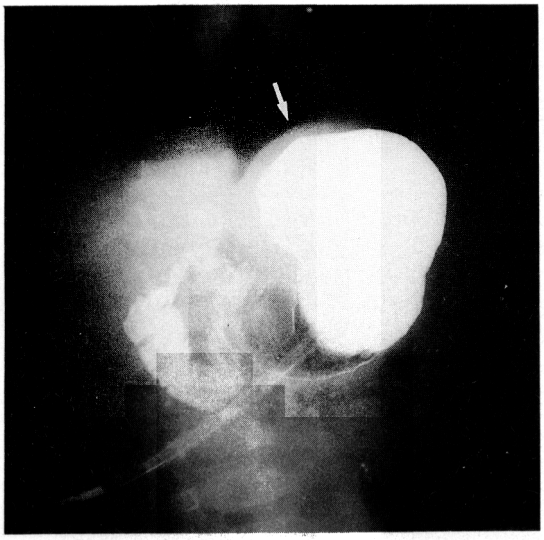

Fig. 1. *Barium contrast study via gastrostomy tube was performed with evoking of gag reflex. This photograph shows the distal short blind pouch (White arrow) without fistula.*

Fig. 2. *The photograph on the 20th postoperative day. The girl eats the soup without difficulty. The healed left cervical incision was marked by arrowheads.*

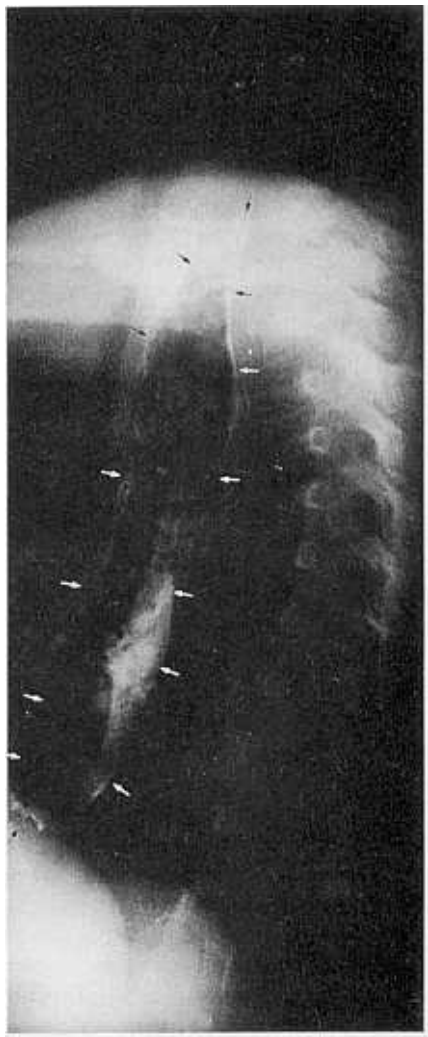

Fig. 3. *The barium meal study on the 14th postoperative day shows the transposed stomach (arrows) in the posterior mediastinum. There was no evidence of anastomotic leakage, stricutre or passage disturbance.*

eration, but it was resolved easily by the chest tube insertions. The patient was ventilated electively for five days. The patient's voice was normal without hoarseness. The feeding via the jejunostomy was started on the third postoperative day. Swallowing of gentian violet on the seventh day did not show any staining via a cervical drain. The drain was removed on the next day.

The careful oral feeding was commenced on the eighth postoperative day. The patient could eat liquid and solid foods without symptoms of poor gastric emptying or gastroesophageal reflux (Fig. 2). The barium meal study on the fourteenth postoperative day showed a good passage without evidence of anastomotic leakage or stricture (Fig. 3). The patient was discharged on the 22nd postoperative day in good condition.

OPERATIVE TECHNIQUE

The supraumbilical transverse incision was made above the gastrostomy site. The gastrostomy was carefully mobilized and the defect in stomach was closed by two layers of interrupted sutures. The greater curvature of the stomach was mobilized with preservation of the right gastroepiploic artery and its vascular arcade. The spleen was carefully preserved (Fig. 4). The lesser curvature of stomach was freed by dividing lesser omentum from the pylorus to the esophageal hiatus. The right gastric artery was carefully identified and preserved while the left gastric artery was ligated and divided at its origin. The lower esophagus was exposed by dividing the phrenoesophageal membrane and the margins of the esophageal hiatus in the diaphragm was defined. The short blind lower esophageal stump was dissected out from the posterior mediastinum by the combination of blunt and sharp dissection through the esophageal hiatus. The vagus nerves were identified and divided. The Kocher's maneuver was performed to obtain maximal mobility of the duodenum. The pyloroplasty was performed (Fig. 5). The whole stomach was enabled to be delivered through the abdominal wound (Fig. 6). The distal blind esophageal pouch and proximal part of stomach was transected at the level of 2nd branch of left gastric artery and closed

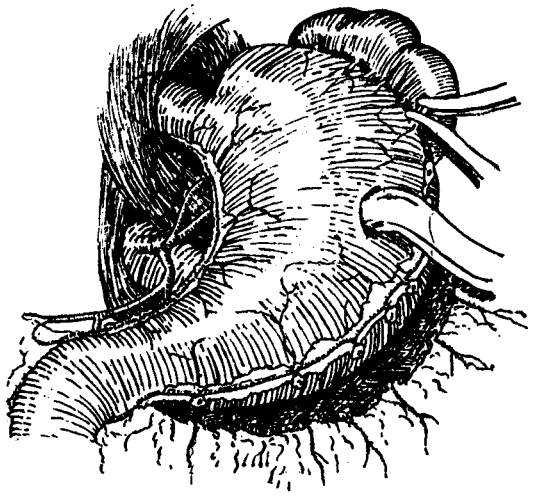

Fig. 4. Mobilization of the greater curvature of the stomach leaving the vascular arcade of the gastroepiploic vessels intact. The short gastric vessels are carefully divided avoiding damage to the spleen.

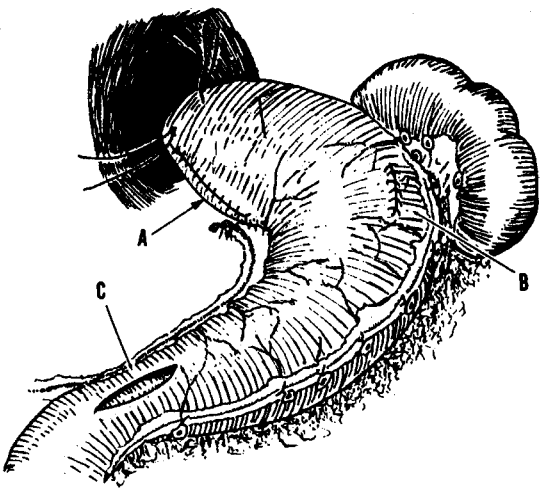

Fig 5. (A) The distal esophageal stump and proximal stomach has been excised and closed with GIA stapler. (B) The gastrostomy tube has been removed and the defect closed. (C) The pyloroplasty has been performed.

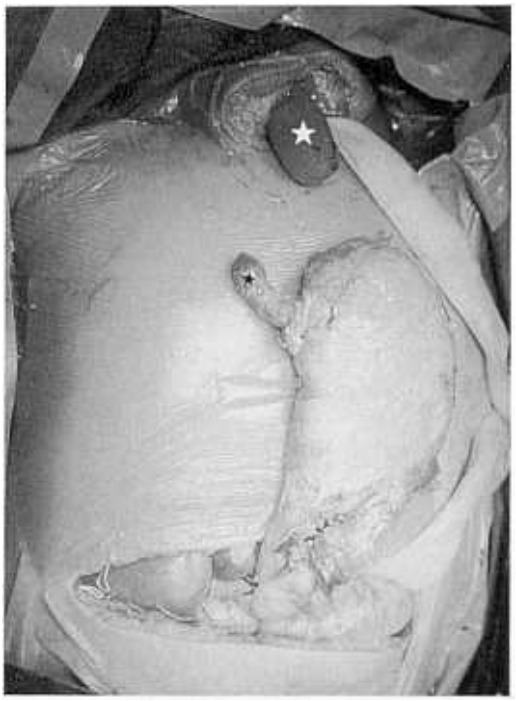

Fig. 6. The completely mobilized stomach was delivered through the abdominal wound. This intraoperative photograph shows short distal esophageal stump (black star), the dilated proximal esophageal stump (white star) and penrose drain which was passed through established posterior mediastinal route.

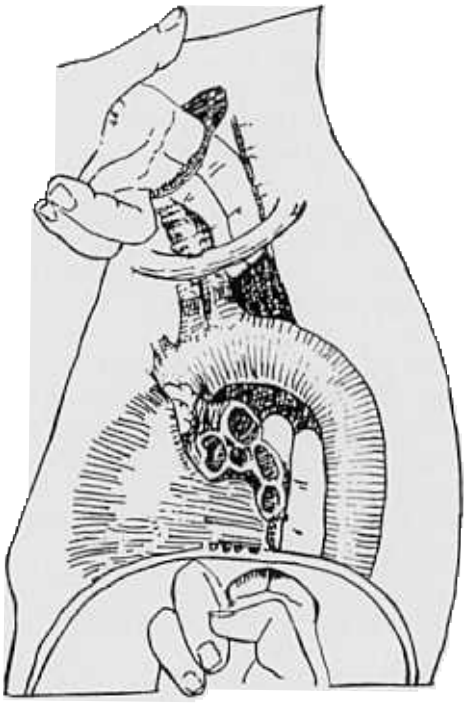

Fig. 7. Creation of the posterior mediastinal tunnel by blunt dissection in the prevertebral fascia from above and via esophageal hiatus in the diaphragm from below.

using the GIA stapler with Lembert's suture reinforcement. The highest part of the fundus was identified and two stay-sutures were inserted into the area selected for the anastomosis.

Next procedure was focused into the neck. The left cervical incision was made along the anterior border of the left sternocleidomastoid muscle and extended from the suprasternal notch to the level of cricoid cartilage. The platysma and omohyoid fascial layers were incised. The sternocleidomastoid muscle, carotid sheath and its contents were retracted laterally. The trachea was retracted medially. The left recurrent laryngeal nerve was identifed and preserved. The upper blind esophageal pouch was mobilized and delivered through the cervical incision by blunt dissection of the superior mediastinum. The dilated upper esophageal pouch was transected at the normal size esophagus.

A tunnel was made into the superior mediastinum by blunt finger dissection. A similar tunnel was made by same maneuver in the line of normal esophageal route through the esophageal hiatus posterior to the heart and anterior to the prevertebral fascia. The continuity of superior and inferior posterior mediastinal route was established (Fig. 7).

A penrose drain was passed into the posterior mediastinal route from the cervical incision and sutured to the fundus of stomach. The penrose drain was gently withdrawn pulling the stomach up into the cervical incision through the esophageal hiatus and the posterior mediastinal route.

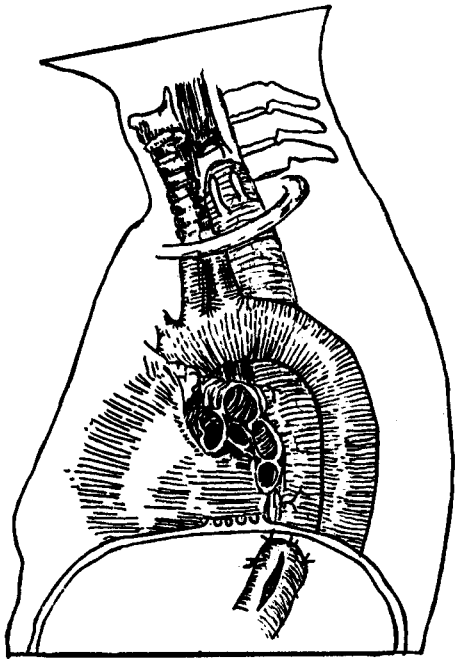

Fig. 8. The stomach has been "pulled-up" through the esophageal hiatus and the posterior mediastinal tunnel. The pylorus lies just below the diaphragm and the antrum is sutured to the edges of the hiatus.

The end of the proximal esophagus was anastomosed to the highest part of fundus of the stomach with continuous suture using inner layer 3-0 polyglycolic acid and outer seromuscular Lembert's #3 silk sutures (Fig. 8). The nasogastric tube was inserted into the stomach through esophagogastric anastomosis to prevent postoperative intrathoracic gastric distention. A silastic drain was placed in the superior mediastinum through the separated stab wound in posterior neck. The cervical incision was closed layer by layer. The margins of the diaphragmatic hiatus were sutured to the antrum of the stomach with interrupted #3 silk sutures. The feeding jejunostomy was made through previous gastrostomy site. The abdominal incision was closed layer by layer.

DISCUSSION

Numerous operative procedures have been described for the esophageal reconstruction in the infants with esophageal atresia. They basically involve either esophageal anastomosis with or without elongation technique, or replacing the esophagus with various substitutes.

Esophageal preservation using delayed primary anastomosis has been commonly performed for the long gap esophageal atresia. There were many esophageal lengthening procedures such as the bouginage of the upper pouch (Howard, Myers, 1965), the combined bouginage of the upper and lower pouches (Hasse, 1975), the olive and thread technique (Rehbein, Schweder, 1971), and the circular esophagomyotomy (Livaditis, 1973). These methods, however, often require many weeks of specialized preoperative nursing care with constant threat of aspiration pneumonia which might develop while waiting for the growth of the esophageal ends. Some pediatric surgeons concluded that even though delayed primary anastomotic repair can be achieved in almost all patients, it would be better for some patients to be treated by esophageal replacement because the prolonged attempt to elongate the esophagus might be hazardous (Ricketts RR *et al.* 1981; Stone MM *et al.* 1986).

Among the methods for esophageal replacement, the colon interposition or the reversed gastric tube esophagoplasty has been most frequently used. The colon interposition has been widely practiced for many years as a method of esophageal replacement in children. The advantage of colon interposition was that the adequate length can be usually obtained. The functional results of the colon interposition have been quite satisfactory, with a relatively low mortality but with a considerable morbidity (Lindahl H *et al.* 1987; Ahmed A, Spitz L, 1986; Kelly JP *et al.* 1983). The rate of leakage and stricture from the upper or lower anastomosis have been reported about 25 % on average (Gross RE, Firestone FN, 1967; German JC, Waterston DJ, 1976; Rodgers BM *et al.* 1978). In some situations, the procedure cannot be performed due to technical matters. Necrosis of the transposed colon caused by venous infarction, technical error, or failure to recognize vascular variations has been report-

ed as high as 8% to 10% in pediatric series (Mitchell IM *et al.* 1989; Ahmed A, Spitz L, 1986).

After Heimlich's report (Heimlich HJ, Winfield JM, 1955), the reversed gastric tube esophagoplasty has been performed for the long gap esopgageal atresia. The reversed gastric tube esophagoplasty has a significant mortality and high morbidity rate when compared with other conventional methods. The rate of leakage from the cervical anastomosis was about 50% and that of late stricture was about 25% (Ein SH *et al.* 1978; Cohen, *et al.* 1974; Anderson KD, Radolph JG, 1978; O' Connor TW, 1983). This procedure needs a long suture line to construct the gastric tube.

The whole stomach can be used to restore the continuity of esophagus in adult. After the Orringer's report, the transhiatal esophagectomy without thoracotomy has been established as an excellent procedure in the patient requiring the removal of a diseased esophagus in adult (Orringer MB, Sloan H, 1978). The excellent long-term result of this method (Orringer MB, 1984), has strongly suggested that pediatric surgeons should try this procedure for children also.

In the series of reports, Spitz suggested the transhiatal gastric transposition through posterior mediastinum was a good alternative procedure for the esophageal replacement in children. He reported the low mortality rate (9%) and morbidity. The incidence of leakage was 12%. There were no instances of failure or necrosis of the gastric transposition. There was no problem of gastrointestinal bleeding, reflux, and aspiration. The incidence of stricture was 9%. The 87% of patients were functionally good or excellent in medium term follow-up (Spitz L, 1984; Spitz L *et al.* 1987; Spitz L, 1992).

The suggested advantages of transhiatal gastric transposition through posterior mediastinum are summarized as follows: (1) This procedure is technically easy. (2) The rate of immediate postoperative pulmonary complications was low because of avoidance of open thoracotomy. (3) By restraining the stomach within the confines of the posterior mediastinum, postprandial gastric dilatation is restricted and pulmonary complication is minimal. (4) It has low incidence of anastomotic leak and stricture due to abundant blood supply and collateral networks of stomach. (5) The cervical leak has lower morbidity and often heals rapidly and easily, without any operative intervention. (6) There is no need to stage the procedures to ascertain that the proximal stoma is well vascularized, which is frequentely recommended after gastric tube esophagoplasty or even the colonic interposition. (7) The route through the bed of intrathoracic esophagus in the posterior mediastinum is shorter than the retrosternal route. Another substantial advantage of this route is that the stomach reaches the proximal esophagus straight, preventing the potential hazard of thoracic inlet obstruction (Marujo WC *et al.* 1991).

Symptomatic reflux and peptic esophagitis have not been reported in pediatric series of gastric transposition, even after long-term follow up (Valente A *et al.* 1987; Holscher *et al.* 1988). In order to reduce the incidence of gastroesophageal reflux, the anastomosis shoud be constructed above the aortic arch. Reflux esophagitis was not a complication of the esophagogastrostomy, provided the anastomosis was high in the thoracic cage, i.e., above the level of the aortic arch (Atwell JD, Harrison GSM, 1980).

The esophageal mucosa is relatively well protected from the peptic acid bath (Skinner DB, Belsey R, 1988). There is also vagotomy effect which almost certainly reduces gastric acidity.

Recently, reported data showed that transhiatal gastric transposition has few respiratory complications either in the immediate or in the late postoperative period (Marujo *et al.* 1991). We also did not experience any significant postoperative respiratory complication.

After total gastric transposition, some infants have developed mild dumping syndrome. Transient dumping syndrome was present in a few patients of transhiatal gastric transposition, but this always disappeared spontaneously after several months (Spitz L, 1992). Dumping syndrome and diarrhea seem to be less frequent in pediatric patients (Postlethwait

RW, 1986). In our case, we found no evidence of dumping syndrome. Vagotomy and pyloroplasty are usually implicated in postoperative dumping syndrome but the precise mechanism is not clear (deLorimier AA, Harrison MR, 1986).

The most simple technical procedure of esophageal replacement is the transhiatal gastric transpositon with cervical esophagogastric anastomosis. The remarkably low operative morbidity and mortality, combined with a satisfactory functional results, indicate that the transhiatal gastric transposition may be the best alternative surgical procedure for the replacement of the esophagus in a long gap esophageal atresia.

REFERENCES

Ahmed A, Spitz L: The outcome of colon replacement of the esophagus in children. *Prog Pediatr Surg 19: 37-54, 1986*

Anderson KD, Randolph JG: Gastric tube interposition: A satisfactory alternative to the colon for esophageal replacement in children. *Ann Thorac Surg 25: 521-525, 1978*

Atwell JD, Harrison GSM: Observation on the role of esophagogastrostomy in infnacy and childhood with particular reference to the long-term results and operative mortality. *J Pediatr Surg 15: 303-309, 1980*

Cohen DH, Middleton AW, Letcher J: Gastric tube oesophagoplasty. *J Pediatr Surg 9: 451-460, 1974*

deLorimier AA, Harrison MR: Esophageal replacement.In Aschcraft KW, Holder TH, eds. *Pediatric Esophageal Surgery.* Philadelphia, PA, Grune & Stratton, *1986, 89-136*

Ein SH, Shandling B, Simpson JS, *et al:* Fourteen years of gastric tubes. *J Pediatr Surg 13: 638-641, 1978*

Gross RE, Firestone FN: Colon interposition of the esophagus in infants and children. *Surgery 61: 955-961, 1967*

German JC, Waterston DJ: Colon interposition for the replacement of esophagus in children. *J Pediatr Surg 11: 227-234, 1976*

Hasse W: Bouginage of the upper and lower segments of oesophagus in oesophageal atresia type 2 (Vogt). *Z Kinderchir 17: 170-177, 1975*

Heimlich HJ, Winfield JM: The use of a gastric tube to replace or bypass the esophagus. *Surgery 37: 549-559, 1955*

Howard R, Myers NA: Esophageal atresia. A technique for elongation the upper pouch. *Surgery 54: 725-727, 1965*

Kelly JP, Schackelford GD, Roper CL: Esophageal replacement with colon in children: Functional result and long-term growth. *Ann Thoracic Surg 36: 634-645, 1983*

Kim CB, Han SJ, Min JS: Clinical experience of transhiatal esophagectomy without thoracotomy. *Korean J Gastr 23: 613-619, 1991*

Lindahl H, Louhimo I, Virkola R: Colon interposition or gastric tube ? Follow-up study of colon-esophagus and gastric tube-esophagus patients. *J Pediatr Surg 18: 58-63, 1983*

Livaditis A: Oesophageal atresia: a method of overbridging large segmental gaps. *Z Kinderchir 13: 298-306, 1973*

Marujo WC, Tannuri U, Maksoud JG: Total gastric transposition: An alternative to esophageal replacement in children. *J Pediatr Surg 26: 676-681, 1991*

Michell IM, Goh DW, Roberts KD, *et al:* Colon interposition in children. *Br J Surg 76: 681-686, 1989*

O'Connor TW: A historical review of reversed gastric tube esophagoplasty. *Surg Gynecol Obstet 156: 371-380, 1983*

Orringer MB, Sloan H: Transhiatal esophagectomy without thoracotomy. *J Thorac Cardiovasc Surg 76: 643-651, 1978*

Orringer MB: Transhiatal esophagectomy without thoracotomy for carcinoma of the thoracic esophagus. *Ann Surg 200: 282-290, 1984*

Postlethwait RW: Resection and reconstruction of the esophagus. In Postlethwait RW, ed. *Surgery of Esophagus.* Nowalk, CT, Appleton-Century-Croffts, *419-524, 1986*

Rehbein F, Schwerer N: Reconstruction of the esophagus without colon transplantation in cases of atresia. *J Pediatr Surg 6: 746-752, 1971*

Ricketts RR, Luck SR, Raffensperger JG: Circular esophagomyotomy for primary repair of long gap esophageal atresia. *J Pediatr Surg 16: 365-372, 1981*

Rodgers BM, Talbert JL, Mozam F, et al: Functional and metabolic evaluation of colon replacement in children. *J Pediatr Surg 13: 35-45, 1978*

Skinner DB, Belsey R: *Reconstruction with stomach.*

In Skinner DB, ed. *Management of esophageal Disease.* Philadelphia, PA, Saunders, *228-245, 1988*

Spitz L: Gastric transposition via the mediastinal route for infants with long-gap esophageal atresia. *J Pediatr Surg 19: 149-154, 1984*

Spitz L, Kiely E, Sparnon T: Gastric transposition for esophageal replacement in children. *Ann Surg 206: 69-73, 1987*

Spitz L: Gastric transposition for esophageal substitution in children. *J Pediatr Surg 27: 252-259, 1992*

Stone MM, Fonkalsrud EW, Mahour G, *et al:* Esophageal replacement with colon interposition in children. *Ann Surg 20: 346-354, 1986*

Valente A, Brereton RJ, Mackersie A: Esophageal replacement with whole stomach in infants and children. *J Pediatr Surg 22: 913-917, 1987*