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Gastric Transposition for Infants with Long-Gap Esophageal Atresia

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Abstract

Objective: **To assess the clinical outcomes of children with long-gap esophageal atresia who underwent gastric transposition.**

Materials and Methods: **Medical records of all patients having gastric transposition at Queen Sirikit National Institute of Child Health were reviewed, including the first case performed in 1994 and subsequent ones up to 2004.**

Results: **Nine infants were included, eight with isolated esophageal atresia, one with a distal tracheoesophageal fistula but long gap. Three had significant associated cardiac anomalies. Ages at gastric transposition ranged from 3 months to over one year. There was no postoperative mortality. Swallowing function improved with time. Weights for age were at or below the 3rd percentile in 8 children. Long-term outcomes were satisfactory.**

Conclusion: **Gastric transposition is a safe procedure in infants, even in the very young. It should be considered in case of long-gap esophageal atresia when esophagoesophagostomy is not possible.**

It has been widely held that a native esophagus is the best esophagus, thus every effort is made to preserve the organ in repairing an esophageal atresia (EA), and the majority of infants with EA can be successfully treated by an esophageal anastomosis. However, in certain circumstances, the gap between the two ends of the esophagus is so long that its anastomosis is not possible and esophageal replacement is required. These include most infants with isolated EA who possess only a short stump of the distal esophagus and some infants with EA and distal tracheoesophageal fistula (TEF) whose TEF opens below the carina into either one of the main bronchi. Various procedures for esophageal replacement, using the colon,[1-9] stomach,[10-22] or jejunum[23-25] as a conduit, have been proposed, each with its advantages and disadvantages.[26-28]

Regarding the advantages of gastric transposition,[14,17] with excellent blood supply, ease of obtaining adequate length, single anastomosis, and low incidence of leaks and strictures, the authors have chosen this procedure for infants who need an esophageal replacement.

The objectives of this communication are to assess

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the clinical outcomes of our patients with long-gap EA who underwent gastric transposition, and to present our technique of gastric transposition, the procedure which has never before been published in Thailand.

Materials and Methods

In the 11-year period from 1994 through 2004, 9 gastric transposition procedures have been carried out at the Children's Hospital, Bangkok. The indication for the esophageal replacement was the inability to repair an EA due to a long gap between the two ends of the esophagus, 8 with isolated EA, and 1 with a distal TEF which opened into the carina by an abnormally small calibered distal esophagus precluding esophago-esophagostomy. During the same period, 193 infants with EA were admitted, of which 20 had isolated EA. Details of these 9 patients are shown in Table 1. All had a feeding gastrostomy performed within a few days after birth. Cervical esophagostomy was avoided, thus prolonged upper esophageal pouch suction had to be maintained prior to gastric transposition.

Weights for age on follow-up visits of each patient were plotted on the Standard Growth Chart for Thai Children of the Ministry of Public Health and the percentile was determined accordingly.

Technique of Gastric Transposition

The procedure is divided into three parts:

1. *Abdominal part:* The patient is placed in the supine position. The abdomen is opened through an upper transverse incision including the previous gastrostomy wound. The gastrostomy is mobilized and the defect in the stomach is closed in two layers. The greater curvature of the stomach is mobilized by ligating and dividing the vessels in the greater omentum and the short gastric vessels, preserving the vascular arcades of the right gastroepiploic vessels. The lesser curvature of the stomach is freed by dividing the lesser omentum from the pylorus to the esophageal hiatus. The right gastric artery is identified and preserved, while the left gastric vessels are ligated and divided close to the stomach. The lower esophagus is exposed and its blind-end stump is dissected out bluntly. The body and fundus of the stomach are now free from their attachments and can be delivered into the wound. The esophagus is transected at the esophagogastric junction and the defect is closed in two layers. The duodenum is kocherized to free the pylorus. A pyloroplasty is then performed. Blunt dissection through the esophageal hiatus in the plane between the heart and the prevertebral fascia is carried out cautiously, creating a posterior mediastinal tunnel which accommodates two fingers easily. The highest part of the fundus of the stomach is sutured to a 26-28 French rectal tube with two sutures of different material, one on the left, another on the right. These two different sutures facilitate orientation and avoid torsion of the stomach during pull-up. The rectal tube is then inserted into the created posterior mediastinal tunnel. The abdominal incision is closed en masse continuously.

2. *Thoracic part:* The patient is turned to the left lateral position. The right arm is extended above the head. An incision is made inferior to the lower border of the scapula, extending from the anterior axillary line to the paravertebral region posteriorly. The thorax is entered through the fourth intercostal space, preferably extrapleurally if feasible. Retraction of the lung anteriorly exposes the posterior mediastinum. The upper esophageal pouch is identified with the gentle pressure on the nasogastric tube by the anesthetist and is dissected free. The previously inserted rectal tube from the abdominal esophageal hiatus is delivered, followed by the stomach. Orientation of the fundus is checked by realigning the different sutures in their correct positions. The end of the upper esophageal pouch is opened and anastomosed to the highest part of the stomach with interrupted 4/0 polyglycolic acid sutures. A 10-French nasogastric tube is inserted into the stomach through the anastomosis. This is to prevent acute gastric dilatation in the early postoperative period. One chest tube is placed and the thoracic incision is closed in layers.

3. *Abdominal part:* The patient is again placed in the supine position. The temporary suture is removed and the abdomen is opened. The position of the antrum is rechecked. The margins of the esophageal hiatus are sutured to the antrum of the stomach with a few interrupted stitches. The abdominal incision is closed in layers.

Final anatomy of the operation is shown in Figure1 by a postoperative barium swallow.

Results

There were no postoperative deaths in this series.

Table 1 Details of 9 patients undergoing gastric transposition

Case No.	Year Performed	Birth Weight (gm)	Type of EA	Associated Anomalies	Age, Weight and Percentile of Weight for Age at GT	Operative Time (hr)	Duration of Post-operative Mechanical Ventilation (day)	Postoperative Complications following GT	Age, Weight and Percentile of Weight for Age at Last Follow-up
1	1994	2,500	Isolated	Hemivertebra	14 mo 10.3 kg p 50	7	1	Adhesive intestinal obstruction (2 yr. after GT) Rx: Adhesiolysis	7 yr 14.5 kg p <3
2	1996	1,600	Isolated	-	4 mo 5.2 kg p10	6	18	1. Abdominal wound dehiscence Rx: Retention suture 2. Cardiac arrest (13 days after GT) 3. Cerebral palsy	1 yr 1 mo 6.2 kg p <3
3	2001	2,450	Isolated	Pilonidal sinus	22 mo 10.6 kg p 25	7	3		5 yr 10mo 13 kg p <3
4	2001	2,000	Distal TEF	TOF, PDA Right sided aortic arch, persistent cloaca	16 mo 6.8 kg p <3	6	6	-	4 yr 6 mo 12 kg p <3
5	2002	2,500	Isolated	-	5 mo 6.6 kg p 25	5	3	-	1 yr 4 mo 9.5 kg p25
6	2003	2,300	Isolated	-	6 mo 6.3 kg p 10	4	5	-	2 yr 8 mo 11 kg p 3
7	2003	2,900	Isolated	-	10 mo 5.4 kg p <3	3.30	-		1 yr 5.4 kg p <3
8	2004	1,040	Isolated	PDA	8 mo 5.7 kg p <3	7.30	7	-	1 yr 7 mo 6.8 kg p <3
9	2004	2,650	Isolated	ASD	3 mo 5.4 kg p 25	3.30	7	-	10 mo 7.3 kg p 3

EA = esophageal atresia
TEF = tracheoesophageal fistula
TOF = Tetralogy of Fallot
PDA = patent ductus arteriosus
ASD = atrial septal defect
GT = gastric transposition

Neither were there anastomotic leaks nor strictures.

Significant incidents regarding esophageal bougienage stretching attempt occurred in two patients; one (case No. 3 in Table 1) had perforation of the upper esophageal pouch requiring thoracotomy and repair of the perforation one and a half years prior to gastric transposition, the other (case No. 7 in Table 1) had a false fluoroscopic image of overlapping esophageal ends on length evaluation leading to thoracotomy which failed to anastomose the actually very long gap EA, gastric transposition was carried out ten months later.

Five infants had birth weight below 2,500 grams and still had been in the low percentile at gastric transposition. (Table 1)

The patients' ages and weights at the time of gastric transposition had been decreasing and proven surgically feasible and safe. Operative times ranged from 3.30-7.30 hours. Recent cases took less time than earlier ones.

The duration of postoperative mechanical ventilation ranged from 0-18 days. The patient who needed 18 days of ventilatory support had abdominal wound dehiscence on the 7th post-operative day requiring retention suturing. Her condition had improved and ventilatory support could be weaned off on the 13th post-operative day. However, she had cardiac arrest that night presumably from obstructed airway by secretion. Cardiopulmonary resuscitation was successful and mechanical ventilation resumed. She subsequently developed cerebral palsy.

Complication in another patient was adhesive intestinal obstruction two years after gastric transposition, requiring adhesiolysis procedure.

Swallowing problems were encountered in all patients in early postoperative period despite sham feeding commenced long before gastric transposition being undertaken. However, they were gradually improved with time and patience. Delay in gastric emptying occurred as a late complication in 2 patients as evidenced by upper gastrointestinal contrast study. These required adjustment of feedings by dividing into small and frequent ones.

The first patient in this series had been followed-up to 7 years of age. The second one who suffered cerebral palsy was lost to follow-up after 1 year of age and presumed to succumb. The other 7 patients have been followed-up to the present.

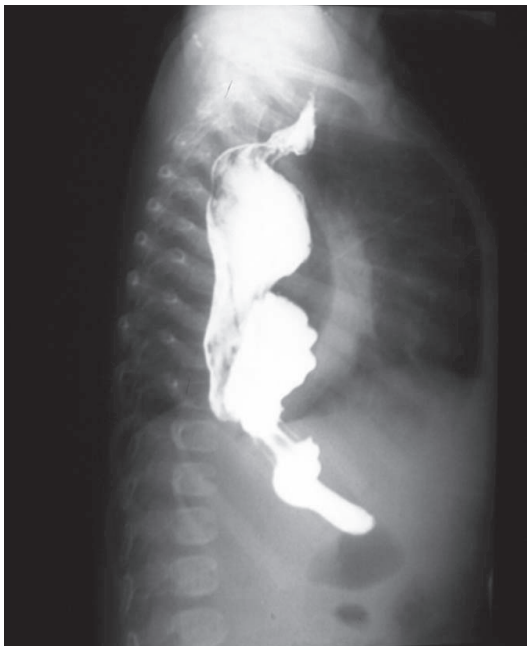

Figure 1 Barium swallow shows the stomach located at the posterior mediastinum in patient no. 7 two months after gastric transposition.

The long-term outcome was considered satisfactory. The children could swallow rather well and had no other gastrointestinal symptoms such as dumping or diarrhea. However, weights for age at last follow-up were at or below the 3rd percentile in 8 patients, while only one was at the 25th percentile.

Discussion

The approach to infants with long-gap EA is controversial and without a perfect solution. On the one hand, attempt to preserve the native esophagus[29-31] at all costs may be futile and end up with leaks and strictures from undue tension anastomosis. On the other hand, esophageal replacement can serve only the purpose of a bridging conduit no matter which part of the gastrointestinal tract is used, and the expectation that the replacement will physiologically serve the child for the rest of his life[19] may be overenthusiastic. Unfortunately, a number of infants with long-gap EA will inevitably need an esophageal replacement.

Gastric transposition and colon interposition are the two most popular choices for esophageal replacement, with the former gaining more popularity recently,[18,19] thanks to its advantages over the latter.

These advantages include better blood supply and ease of obtaining adequate length thus rare graft loss, single anastomosis, low incidence of leaks and strictures, no problems of later conduit redundancy, hence by and large less postoperative complications and mortality.[9,17-19] Furthermore, satisfactory quality of life on long-term follow-up for patients with EA undergoing gastric transposition has been reported.[32,33]

Bougienage stretching of the esophagus prior to anastomosis must be carried out with great care, or else not done at all, since over-stretching can result in perforation as occurred in one of our patients. Moreover, gap length evaluation by such stretching may be misleading to underestimation of the gap if too much force is applied as seen in one patient. In our opinion, the drawbacks of bougienage stretching of the esophagus in infants with isolated EA outweigh its benefit, if any. They usually possess only a short stump of the distal esophagus hence esophagoesophagostomy is hardly possible.

Our technique of gastric transposition with open thoracotomy is to pull the stomach up through the posterior mediastinal tunnel under direct vision. Without a preliminary cervical esophagostomy, esophagogastric anastomosis can be done easily via this thoracotomy. The overall procedure is safe even in small infants.

The earlier the procedure is carried out, the less suffering the child will be; i.e., the child can be fed orally and has a shorter hospital stay. From our experience, we suggest that gastric transposition be carried out in infants at 3-6 months of age. By taking their birth weight into consideration, one with normal birth weight can undergo the procedure as early as 3 months of age, while those with low birth weight should be operated upon at a later age. This clearly is the advantage over colon interposition which usually has to be done in infants over one year old.

Delay in gastric emptying is caused by vagotomy during the dissection of the stomach. Concomitant pyloroplasty can alleviate the symptom in the majority of patients. Inadequate dilatation of the esophageal hiatus may be another contributing cause and should be of concern during the procedure.

Regarding the low percentile of weight for age in all these children, the majority of them had low birth weight initially and still had been in the low percentile at the time of gastric transposition and thereafter. In the meantime, gastrostomy feeding prior to gastric transposition was at times inadequate as these children were growing up and their nutritional requirements had been increasing. Early gastric transposition may lessen this problem when oral feeding can be initiated and intake is more optimal. Furthermore, associated cardiac anomaly is another contributing factor to poor weight gain which needs close long-term follow-up.

In conclusion, gastric transposition is a safe procedure in infants, even in the very young. It can be undertaken at a much earlier age than can colon interposition, and should be considered in case of long-gap EA when esophagoesophagostomy is not possible.

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