Esophageal Reconstruction with Jejunum or Colon

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During the last 4-year period 25 children from 9 months to 15 years underwent esophageal reconstruction with interposed segment of colon or jejunum. The diagnosis was: long-gap atresia—17 cases, chemical burns—6 and Barrett's esophagus—2. Esophagus was reconstructed with colon in 18 cases and jejunum in 7 cases.

Among early complications upper anastomotic fistula was diagnosed in 6 patients and upper anastomotic stricture in 1. There were 2 cases of graft necrosis. The follow up was from 3 months to 4 years. One patient died 12 months after surgery due to a reason not related to esophageal reconstruction. Six patients developed late stricture of upper anastomosis, 6 patients bled due to gastric reflux after colonic interposition. All remaining patients but one, who is still waiting for another reconstruction after graft necrosis, are doing well with only oral feeding.

Key words: Esophageal substitution, Jejunum interposition, Colon interposition.

The dilemma, which part of the intestine, colon or jejunum, is a better substitute for the pediatric esophagus remains unsolved. Both methods should be reviewed regarding their technical demands, effectiveness and applicability of neck and stomach anastomosis, time and type of emptying, ability to resist gastric reflux, frequency of early and late complications, and late results. Colonic interposition has more advantages due to the relative simplicity of the technique, very high applicability, and low risk of ischemia.1,2 Jejunal grafts are less popular because of its high sensitivity for ischemia, greater technical difficulty, and significantly longer time of operation.3,4 On the other hand a jejunal graft preserves propulsive peristalsis, while a colonic one remains only a rigid conduit, emptying with gravity.1,4 We present our 4 years’ experience of esophageal substitution using different parts of the intestine.

Materials and Methods

Between 1998 and 2001, 25 children underwent esophageal reconstruction with interposed segment of jejunum or colon in our institution. Their age ranged from 9 months to 15 years, body mass was from 6 to 33 kg, mean 14.5 kg. The indication for
esophageal reconstruction was long-gap esophageal atresia in 17, chemical burn in 6, and Barrett esophagus in 2. Eight patients had previously unsuccessful attempts of esophageal reconstruction: primary esophageal anastomosis in 2, gastric tube in 3, Collis-Henderson gastroplasty in 2, Kimura's esophageal elongation in 1. Three patients underwent Nissen fundoplication and pyloroplasty and 1 a tracheostomy. Some patients with congenital esophageal atresia had associated anomalies - heart failure in 5, Down’s syndrome in 3, hydrocephalus in 1, microcephaly in 1, retinopathy in 1, kidney agenesis in 1, jejunal duplication in 1 and epilepsy in 1.

Eighteen patients underwent esophageal reconstruction using interposed colon; transverse in 10, ascending colon with ileal segment in 1, jejunal segment interpositions in 7. The intestinal graft was always oriented isoperistaltically and located in the posterior mediastinum in 15 and the anterior mediastinum in 10. Early complications have been listed in Table 1.

### Table 1: Early Complications

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Anastomotic Fistula</td>
<td>6</td>
</tr>
<tr>
<td>Necrosis of Graft</td>
<td>2</td>
</tr>
<tr>
<td>Upper Anastomotic Stricture</td>
<td>1</td>
</tr>
<tr>
<td>Kinking of Lower Anastomosis</td>
<td>2</td>
</tr>
<tr>
<td>Gastric Perforation</td>
<td>1</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1</td>
</tr>
</tbody>
</table>

Late upper anastomosis stricture was diagnosed in 6 patients (24%); this was treated with endoscopic dilatation. Six patients (24%) developed significant bleeding from ulceration at the distal part of the interposed colon just above the lower anastomosis. Two of them underwent resection of the distal part of the colon which were reconstructed with a jejunal segment. One patient died one year after operation due to severe pneumonia.

**Observations and results**

The follow up is from 3 months to 4 years. Of the 2 patients with necrosis of the interposed graft the first one underwent esophageal reconstruction with total gastric transposition and the second one is still waiting for the next step. All the remaining patients are on normal diet. Patients with inflammation of the distal part of the interposed colon are treated medically. Two of them are without graft inflammation following jejunal interposition graft.

**Discussion**

The indications for esophageal substitution in pediatric patients differ significantly from the ones in adult surgery, in whom this operation is predominantly performed for oncologic reasons. Reconstruction undertaken in young patients should fulfill a long term purpose, not exclusively for short-term palliation. The pediatric neoesophagus should not only restore connection between mouth and stomach, but also preserve a straight shape, sufficient blood supply, peristalsis for emptying and resistance to gastric reflux. It must also grow with the elongation of the patient's thorax, and even be cosmetically acceptable. The gold standard of esophageal substitution does not exist. Different centers achieve good late results after different techniques of esophageal substitution. The most common method of esophageal
reconstruction is colon interposition.

Long gap esophageal atresia, primary or secondary after unsuccessful attempt of its anastomosis or failed reconstruction remains the most common indications for esophageal substitution. Patients following chemical burns of esophagus with tracheoesophageal fistula or long circumferential scars, who did not improve with combination of endoscopic and thread dilatation therapy are candidates for esophageal substitution. The third group of patients consists of those with gastric mucosal metaplasia (Barrett esophagus) of the entire esophagus and a narrow cicatrix resistant to medical therapy and antireflux surgery.

Esophageal reconstruction is feasible even in neonates, but better results could be expected in older patients. In our institution this type of surgery is undertaken in patients weighting not less than 6 kg. This weight assures satisfactory caliber of mesenteric vessels of the jejunum, that significantly increase the safety of preparation and transposition of the vascular pedicle. The blood supply to the interposed intestine most frequently gets compromised at the thoracic inlet. Asthenic type of thorax with a narrow space surrounded by vertebral column, trachea and vessels increases the risk of ischemia of the proximal part of the interposed intestine.

Warm, humid and alkaline environment of salivary secretion favors bacterial colonization. Very often the germs are highly resistant to most antibiotics. Infection of the upper anastomosis threatens a fistula in almost all cases. In our center multiple cultures are taken from fistula and gastrostomy. Any evidence of their pathogenic colonization is a contraindication for surgery.

Our experience indicates the functional advantage of esophageal reconstruction with jejunal segment interposed in the posterior mediastinum. In our series this method was applicable only in about 25% of cases due to the design of the vascular arcades in the mesentery. Very complicated jejunal grafts should also be abandoned in spite of good blood supply. Reconstruction with this type of jejunal segment creates too long a loop with high risk of its kinking and obstruction. The second favorite method is interposition of a colonic segment, which consists of distal part of ascending colon, the whole of transverse and proximal descending colon. A high incidence of severe inflammation of the distal part of the interposed colon because of gastric reflux led us to a simultaneous creation of a jejunal implant between colon and stomach. Preliminary results of this technique revealed complete resistance of the jejunal segment to gastric content reflux and protection of the distal part of colon. The third method is total gastric transposition in the posterior mediastinum.

We prefer isoperistaltic orientation of the interposed intestinal graft that probably creates some kind of antireflux mechanism and shortens the transit time. Localization of the graft in the posterior mediastinum is logical and more physiological. Moreover it needs a shorter segment of interposed intestine and decreases the risk of compression on the vascular pedicle. A relatively narrow tunnel in the posterior mediastinum does not allow interposed colon for segmental over dilatation. Its natural haustration protects it from...
retention of the meal thus avoiding inflammation and ulceration.

More rigid posterior passage prevents the creation of a complicated shape of the jejunal graft. The choice of route also depends on the type and results of previous attempts at primary anastomosis or reconstruction. Attention should also be paid to the existence of heart failure that would need surgical correction in future.

Necrosis of the end or the entire interposed intestine is the most serious complication of esophageal reconstruction, which is followed by high mortality and morbidity. Most commonly it is the result of the damage of its vascular pedicle during preparation. The pulling-pushing maneuver of the graft through the mediastinum, a narrow distal orifice of the tunnel and swelling of the graft and surrounding tissues during the perioperative period are contributory factors. To some extent it is also affected by existing or new infection. The ischemia of the graft is provoked not only by decreased arterial blood inflow, that is easily recognizable as a lack of normal pulsation, but also by blood outflow stasis with hyperemia, swelling and weakened barrier function of the intestinal wall. Necrotic graft should be resected immediately, and the next step of reconstruction could be planned in a few months. In our center the next procedure used is total gastric transposition.

Gastric reflux is the most frequent late complication of esophageal reconstruction with colon, neither isoperistaltic orientation of the graft, nor “antireflux” techniques of anastomosis with stomach, nor pyloroplasty prevent the pathologic back flow of gastric contents. The reflux produces inflammation of the distal part of the interposed colon with ulceration and sometimes severe bleeding, which does not respond to even intensive medical treatment. Untreated or ineffectively treated gastric reflux results in segmental distension, stricture of the interposed intestine, retention of swallowed meal and increase of symptoms.

Jejunal supplement on a separate pedicle, between the distal end of the interposed colon and stomach, is one of the surgical methods to treat and prevent gastric reflux. We have employed this technique successfully a year after colonic interposition, and recently we have introduced it as a routine along with colonic interposition.

The shape of the interposed jejunum remains wavy. Too long a jejunal loop under the diaphragm could create a symptomatic barrier for the smooth outflow of the meal. Excess of the loop should be resected using delicate and precise ligation of the mesentery close to the intestinal wall to avoid any damage of the pedicle.

The results of esophageal reconstruction in our series are promising. The patients have normal growth and they accept normal diet.

Conclusions

Jejunal or colonic segment interposition is an effective method of esophageal reconstruction; better long term results could be expected after jejunal interposition.
References


