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ORIGINAL ARTICLE

Early one-stage orthotopic jejunal pedicle-graft interposition in long-gap esophageal atresia

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Abstract. Since 1988, four children with long-gap esophageal atresia have undergone one-stage orthotopic jejunal pedicle-graft interposition at the age of 2 to 3 months. Obtaining enough jejunal length was no problem and major early complications did not occur. In one patient stenosis of the distal anastomosis was problematic and required corrective surgery. None of the patients demonstrated jejunitis as a result of gastroesophageal reflux. With follow-up periods of 12, 27, 46, and 60 months, all patients are doing well. It is concluded that the jejunum is a better esophageal substitute than is generally appreciated.

Key words. Jejunal replacement of esophagus – Jejunal interposition – Long-gap esophageal atresia

Introduction

Occasionally, esophageal replacement may be required in children with long-gap esophageal atresia (EA). Several substitutes can be used, e.g., colon, gastric tube, total stomach, and jejunum [2, 7]. Jejunum has not gained wide acceptance, presumably because of the difficulty of gaining enough length, the poor blood supply, and the low resistance to gastric juice [2, 10]. The advantages of using jejunum, however, are its size, which is similar to the esophagus, and the retention of good peristaltic activity [5, 9, 12]. We report our experience with early one-stage orthotopic jejunal pedicle-graft interposition in patients with long-gap EA.

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Materials and methods

Since 1988, four children with EA have received a jejunal interposition. The demographic data are summarized in Table 1. All patients received a gastrostomy shortly after birth. The diagnosis of the existence of a proximal fistula was made in two of the three patients with a proximal fistula by tracheoscopy during the anesthetic for the creation of the gastrostomy, but was missed in the third. We decided to leave the fistula undisturbed until the planned jejunal interposition procedure. The timing of the interposition was arbitrarily chosen at 2 to 3 months of age (Table 2). Meanwhile, a double-lumen 10 F catheter was placed in the upper esophagus for continuous suction. In the child with a recurrent tracheoesophageal fistula after primary repair using a flap technique [4, 11], a long, fibrotic segment of esophagus that required replacement was unexpectedly encountered during the planned operation for closure of the recurrent fistula.

All children had a standard, right-sided posterolateral thoracotomy through the 5th intercostal space. The esophagus was approached extrapleurally except in the child with the recurrent fistula. The proximal esophageal pouch was identified by pressure exerted on the tube in the proximal esophagus by the anesthesiologist, the distal pouch by introducing a small Hegar dilator through the gastrostomy. In all cases it was clear that an interposition procedure was unavoidable. The thoracotomy was then closed provisionally.

Three children also had a right transverse cervical approach in order to mobilize the proximal esophagus as far as possible. The proximal fistula was divided through the neck in two of the three patients. In the remaining patient with a proximal fistula and the one with a recurrent fistula, the fistula was divided via the thoracotomy.

The abdomen was opened through an upper midline incision. The esophageal hiatus was identified and opened posteriorly toward the previously opened posterior mediastinum. The jejunum was than transected about 10 cm from the ligament of Treitz (Fig. 1 a). About 20 cm of distal jejunum was mobilized, keeping the vascular supply intact. The first and, when needed, the second major branch of the superior mesenteric vessels was ligated and transected close to the base of the mesentery. The distal 15 cm of mobilized jejunum were removed as close to the bowel wall as possible, leaving the most proximal 5 cm intact (Fig. 1 b). In all cases a well-vascularized jejunal segment with a long pedicle was obtained. The graft was brought up behind the pancreas and stomach and through the posterior portion of the hiatus. The route was made sufficiently wide using Hegar dilators in order to allow free passage of the graft and its blood supply. The pedicle was regularly checked to make sure that no twisting or kinking had occurred. Small-bowel continuity was restored anterior to the vascular pedicle of the graft.

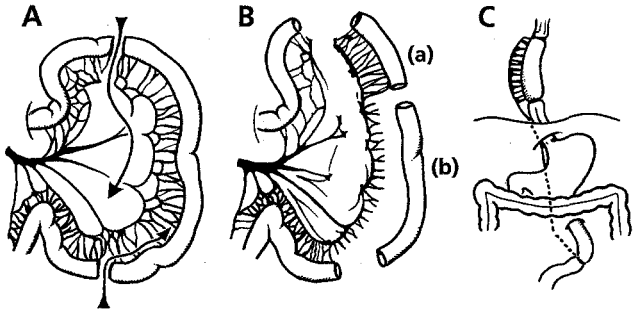

Fig. 1. a Jejunum transected about 10 cm distal to ligament of Treitz. One or two major blood vessels are ligated and transected, keeping arcades intact. Jejunum again transected 20 cm more distally, leaving arcade intact. **b** The first 5 cm of jejunum are carefully preserved (**a**) but distal 15 cm (**b**) are removed, transecting vessels as close to bowel wall as possible. **c** Jejunal pedicle graft has been brought into right chest behind pancreas and stomach, through posterior hiatus, and interposed between esophageal ends. Jejunal bowel continuity has been restored (modified after Saeki et al. [9])

The thoracotomy wound was reopened and the jejunal graft was interposed between the esophageal ends. The graft lay stretched in the posterior mediastinum after any excess had been trimmed away, preserving the blood supply (Fig. 1c). A nasogastric tube was passed through the jejunal graft and secured. The gastrostomy was closed in all four patients at the beginning of the abdominal phase of the operation, but was refashioned at the end. The total procedure took 4 to 5 h.

All patients had a contrast study 1 to 2 weeks after the interposition. Feedings were started by gastrostomy. Once full enteral feeding was established through the gastrostomy, oral feedings were commenced.

Results

The results in all four patients are shown in Table 2. All patients survived; no grafts were lost. The children remained intubated postoperatively for 1 to 9 days. One patient developed a high temperature for a few days. Contrast radiographs showed good proximal-to-distal peristaltic activity in all cases. In two patients no sign of obstruction was noted; a proximal stenosis with a small extraluminal sinus was noted in one and a distal stenosis in another. The patients went home 13 to 46 days after the interposition.

The gastrostomy was closed at the age of 5 to 14 months. In the child who had the gastrostomy for the longest period, it could have been closed much earlier but the mother preferred that it be left in place. No dilatations were carried out in two patients; the patient with the proximal stenosis had five dilatations. During the last session the graft was accidentally perforated distally, requiring operative closure. Meanwhile, he is doing well without further dilatations.

The last patient had a troublesome course. From the start it was noted that the distal anastomosis was narrow. Despite numerous easy dilatations, indicating functional obstruction, oral feeding remained problematic. He also had recurrent respiratory infections that were possibly related to a

Table 1. Demographic data

Child	1	2	3	4
Gestation (weeks)	34	38 3/7	33 5/7	36 2/7
Birth length (cm)	47	48.5	48	48
Birth weight (g)	2,000	2,550	2,250	2,500
Type of atresia	proximal fistula	proximal fistula	distal fistula	proximal fistula
Other anomalies	none	none	minor dysmorphism deafness retardation	microtia hypoplasia of right face cervical scoliosis floating thumb

Table 2. Treatment and outcome

Child	1	2	3	4
Primary surgery	gastrostomy	gastrostomy	flap-technique [4, 11] gastrostomy	gastrostomy
complications	gross leakage of gastrostomy	none	recurrent fistula, long stenosis	none
Jejunal grafting age in days	91	67	49	54
postoperative intubation in days	2	1	5	9
early complications	none	high temperature	none	none
postoperative hospital stay in days	32	13	35	46
Follow-up				
period in months	12	27	46	60
late complications	none	accidental perforation	distal stenosis requiring surgery	none
gastrostomy removal (age in months)	6	5	11	14
oral feeding	no problems	no problems	borderline intake	no problems
pH study	–	–	normal	normal
esophagoscopy	–	normal	normal	normal
growth	sufficient	sufficient	marginal	sufficient

poorly emptying esophagus. It was finally decided to correct the stenosis surgically 21 months after the interposition. Through a transabdominal and transhiatal approach, the distal esophagus was mobilized up to the stenotic anastomosis, which was widened by a vertical incision and transverse closure. As the obstruction appeared functional rather than anatomic, a myotomy of the distal esophagus was performed in combination with a Thal-type fundoplication because distal esophageal myotomy predisposes to gastroesophageal reflux (GER). A pyloromyotomy was also done as the vagal nerves had not been identified. Since that time, several more dilatations have been carried out; at this time he is doing well on oral feedings.

None of the patients presented with symptoms indicating GER. Vomiting has not been observed in any case and reflux of contrast material has never been noted during any of the contrast studies that have been performed. Inflammation of the esophagus or its substitute was not seen in the three patients who were endoscoped at the time of the dilatations. Two patients had pH studies, and these were normal. Only one patient has not had either a pH study or esophagscopy, but he has no symptoms and the parents have not been cooperative in this respect. Growth has been satifactory in all but one patient.

Discussion

Jejunum has been used as an esophageal substitute, but is a bowel segment not preferred by most surgeons [2, 7, 10]. Quoted disadvantages are the precarious blood supply, the difficulty in gaining adequate length, and the low resistance of small bowel to gastric juice. Ring et al. [8], however, published a series of 32 staged jejunal interpositions with a follow-up of 18 to 33 years. In none of their cases did the procedure have to be abandoned because of inadequate length or necrosis, although they used the long antesternal route. Peptic ulceration was never noted. In a series of lower esophageal replacements with jejunal pedicle grafts for benign disease in adults, Wright and Cuschieri found no ulcerations at long-term follow up [12]. In our series ulceration has also not been a problem. Because of the supposedly precarious blood supply, most surgeons replacing the esophagus with jejunum have used a staged procedure and/or have avoided the transthoracic route [1, 3, 8].

Professor Kasai's mention of the successful use of orthotopic jejunal pedicle grafts in patients with cancer of the lower and middle third of the esophagus motivated us to use such grafts in children. The technique was developed in Sendai, Japan, by Katsura et al. [6] in the 1950s. This technique essentially does not differ from the technique described by Saeki et al. [9]; we do not, however, transect the marginal vessels distal to the main blood supply of the graft, as this is not necessary and these contribute to the vascularization of the graft. Gaining enough length was not a problem in our patients, and none has developed peptic ulcers so far. By keeping the interposed graft as short as possible, redundancy is avoided. We believe it is too risky to use free grafts, as has recently been advocated by Cusick et al., nor do we think that pedicle grafts need a dual blood supply by anastomosing the arcade vessels in the neck [1]. Well-vascularized pedicle grafts can easily reach the neck when 30 to 40 cm of jejunum is sacrificed [3, 9]. Much less jejunum is needed if no previous cervical esophagostomy has been made.

It is important to note that none of our patients had a preliminary cervical esophagostomy or division of the proximal fistula in order to save as much proximal esophagus as possible and prevent the complications of later mobilization of the esophagostomy, e.g., loss of proximal esophageal tissue and damage to the recurrent laryngeal nerve. The children with a proximal fistula tolerated this situation quite well, but continuous suction in these patients was obviously required. It is important to clean or replace the double-lumen suction catheter at least once a day to prevent obstruction and aspiration. Moreover, the salivary losses and especially the resulting sodium loss have to be replaced in order to maintain normal growth.

We agree with several other publications that intrathoracic jejunal pedicle graft interposition with preservation of the lower sphincteric activity is a recommendable procedure when esophageal replacement is required [6, 9, 12]. In these publications, however, jejunal interposition was not carried out before the age of 6 months and was sometimes even delayed until the age of 18 months. We believe it is preferable not to delay the definitive operation for more than 2 or 3 months, and our experience shows that it can be done well at that age. Early reconstruction will prevent the problems that are so often encountered when oral feeding has been witheld for a long time.

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