Abstract Long-gap esophageal atresias (EA) generally require surgical substitution using colon, jejunum, or a portion of the stomach. In these procedures, as in total gastric pull-up operations, the distal portion of the esophagus is sacrificed. Experimental studies on cadaver stomachs have shown that retrosternal transfer of the distal esophagus with preservation of all esophageal portions is possible when the lesser curvature is incised diagonally, provided the collateral circulation via the left gastric artery (LGA) is preserved. A tension-free esophageal anastomosis is then carried out intrathoracically or cervically. This technique was employed successfully in eight children. In two cases ligation of the LGA alone was sufficient; in six an additional incision in the lesser curvature was required to achieve adequate length. This procedure is advantageous in that all portions of the esophagus are preserved and, due to the retrosternal position, a thoracotomy is unnecessary. The morbidity is significantly lower than that associated with all the other substitution techniques. The main complications included cervical anastomotic leaks, which closed spontaneously, and stenoses that required bouginage. There was no mortality. From our experience to date, it can be concluded that esophageal anastomosis is possible in long-gap EA after incising the lesser gastric curvature, and that substitution plasties can be avoided.

Key words Esophageal atresia • Replacement technique

Introduction

The treatment of long-gap esophageal atresia presents a major challenge to the pediatric surgeon, and a variety of solutions have been proposed. Short gaps can be managed by lengthy courses of bouginage or various myotomy techniques. Substitution plasties using colon, jejunum, or the greater gastric curvature are difficult procedures that are associated with high morbidity and mortality [1].

These methods, as well as total gastric pull-up, have the additional disadvantage that the distal esophagus and cardia are sacrificed.

In this journal [4], we have described a technique that permits 6–8 cm to be spanned by lengthening the lesser gastric curvature (LC). It has the advantages of preserving all portions of the esophagus as well as the cardia and is associated with a low morbidity. In this paper, we shall examine the results and describe further experience with this method.

Materials and methods

In most esophageal substitution plasties, the proximal portion of the esophagus is preserved and the distal portion sacrificed. The question of whether the distal esophagus and cardia can be preserved for a direct esophageal anastomosis needs to be clarified.

Vascular supply of the distal esophagus

Numerous autopsy studies have demonstrated that mobilization of the distal esophagus is limited by the ligamentous and vascular fixation of the LC, especially the left gastric artery (LGA). In addition, the blood supply to the distal esophagus is largely dependent on this artery, as has been shown by vascular preparations and angiographic studies. The collateral circulation from the deep and short gastric arteries in most cases flows via the LGA, so that ligation of this artery leads to inadequate perfusion of the distal esophagus (Fig. 1).

Mobilization of the lesser curvature

Adequate vascularity of the distal esophagus is ensured when the LGA is divided deep in the main margin after the second bifurcation to the stomach. This measure alone suffices to gain 2–3 cm in length.

Calculation of esophageal length

A diagonal incision of the LC is made using the GIA stapler after the second bifurcation. The length of the incision doubles the elongation of the cardia and distal esophagus; a 3-cm incision of the LC thus produces a 6-cm gain in length. To transfer the preparation, it is necessary to shift the spleen and short gastric vessels somewhat medially (Fig. 2).
Fig. 1 Collaterals of the cardia and lower esophagus. a Left gastric artery, b second gastric branch of left gastric artery, c short gastric arteries, d deep gastric artery

Fig. 2 Ligation of left gastric artery close to main trunk and after second branch. Division of lesser curvature using GIA stapler. Length of incision provides twofold lengthening of cardia and distal esophagus.

Gastric emptying

Since mobilization of the esophagus compromises at least the anterior branch of the vagus, a functional pyloric stenosis could result. It is thus advisable to perform a pyloromyotomy or pyloroplasty.

Clinical examinations

We originally performed orthotopic esophageal transfer, i.e., intrathoracically. Although this is technically feasible, it entails substantial disadvantages. The changes in intrathoracic pressure due to respiration predispose to gastroesophageal reflux (GER), and furthermore, the intrathoracic route is no shorter than the retrosternal route. The incidence of pulmonary complications (pneumonia, atelectasis) is higher when the intrathoracic approach is used, and thus, it is preferable to use the retrosternal technique.

Proximal cervical esophagostomy

If a primary anastomosis of the esophagus is not possible, an esophagostomy should be performed as early as possible in the cervical region (Fig. 3). Sham feeding allows preservation of the swallowing reflex, so that disorders of swallowing will not occur following a successful anastomosis. As the child grows, the proximal esophagus will elongate spontaneously. Bouginage of the esophagus in situ tends to cause dilatation rather than lengthening, and aspiration is common when this is performed.

Gastroesophageal reflux

Even when a Thal antireflux procedure or semifundoplication is performed, GER without vomiting is common in the initial postoperative period. In none of our cases, however, did the reflux lead to endoscopically detectable esophagitis. Precise studies of the gastric acidity are not yet available, however, examination of specimens of gastric juice indicate that there is only slight acidity.

Patients

Details of the technique have previously been described in this journal. To date, eight patients have been treated by the author using this method. In two, ligation of the LGA alone sufficed to achieve an esophageal anastomosis. In six cases a diagonal incision of the LC 3–4 cm in length produced 6–8 cm esophageal lengthening, and a single-layer esophageal anastomosis was carried out in the neck. Subsequent radiographic studies routinely demonstrated a retrosternal position (Fig. 4). Oral feeding was started 2–4 weeks postoperatively, after which additional gastrostomy feedings could be discontinued.

Gastric emptying occurred promptly in all cases. All the children showed normal physical and psychointellectual development. Follow-up periods ranged from 6 months to 10 years.

Results

Two children developed cervical fistulas that closed spontaneously. In four cases the anastomosis required 1–8 bougienages. In two cases unchewed sausage boluses became entrapped and required endoscopic removal.

Radiologic contrast swallows demonstrated reflux in the intrathoracic portion of the stomach in all cases; in seven, however, it occurred only transiently in the distal esophagus, and the patients had no vomiting or endoscopic signs of esophagitis. In one patient who had undergone intrathoracic esophageal transfer, postprandial symptoms were attributed to reflux; both the symptoms and the reflux ceased promptly after a semifundoplication. At this operation, furthermore, it was noted that the entire esophagus had increased in length by several centimeters since the original procedure, so that the antireflux operation could easily be performed transabdominally.

One child who had undergone a retrosternal operation had a swallowing disorder due to gastric kinking and required resection of a tissue spur. Aspiration occurred only in patients with esophageal stenosis, who were treated by regular, long-term bougienage. The complications observed are summarized in Table 1.