Thoracoscopic and laparoscopic esophagoplasty for congenital esophageal stenosis

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A congenital esophageal stenosis (CES) is a rare anomaly, and therapeutic strategies are still controversial. Two children with CES located in the lower esophagus, who were treated by endoscopic esophagoplasty that consisted of partial esophageal resection and transverse anastomosis, are reported. A 23-month-old boy with CES at the level of T9 underwent esophagoplasty thoracoscopically. A 13-month-old boy with CES at the level of T10 underwent esophagoplasty followed by anterior partial fundoplication laparoscopically. Both patients are asymptomatic and eat normally 5 years and 6 months after surgery, respectively. Thoracoscopic or laparoscopic partial resection of the esophageal wall and transverse anastomosis are considered effective, less invasive, and safe in the treatment of CES.

Congenital esophageal stenosis (CES) is a rare anomaly, with an incidence of about one per 25,000–50,000 live births [1]. CES is divided into 3 types: tracheobronchial remnants (TBR), fibromuscular thickening (FM), and membranous webbing (MW). The therapeutic strategies, including endoscopic balloon dilatation and resection of the stenotic site, are still controversial [2–8]. Conventionally, esophageal resection has been performed via either laparotomy or thoracotomy depending on the stenotic site. Recently, thoracoscopic or laparoscopic surgeries have been reported for the treatment of CES [9–12]. The cases of two children with CES located in the lower esophagus, who were treated by endoscopic esophagoplasty that consisted of partial esophageal resection and transverse anastomosis, are described. A thoracoscopic approach was used in one, and a laparoscopic approach in the other.

1. Case reports

A 23-month-old boy and a 13-month-old boy were admitted to our hospital for vomiting due to foreign body impaction in the lower esophagus. The esophagogram and endoscopy showed a lower esophageal stricture at the level of T9 and T10, respectively (Fig. 1). The proximal esophagus was moderately dilated. Endoscopic ultrasonography (EUS) was performed to distinguish between TBR and FM, and it did not show aberrant cartilage in both cases. The patients initially underwent balloon dilatations 3 and 4 times, respectively, with no significant effect. Partial resections of the esophageal wall were performed by less invasive surgery in these two children with CES. Histologic studies revealed FM in one and TBR in the other.

1.1. Case 1: 23-month-old boy with CES at the level of T9 due to FM

Partial esophageal resection and transverse anastomosis by a thoracoscopic approach were performed for stenosis at the level of T9 (Fig. 1A). One-lung ventilation by right mainstem intubation was carried out for optimal surgical visualization. The patient was then placed in the right lateral decubitus position. Four 5-mm ports were inserted into the left thoracic cavity in the fourth intercostal space, midaxillary line for the 5-mm 30° scope; fifth intercostal space, anterior-axillary line; seventh intercostal space, anterior-axillary line; and seventh intercostal space, posterior axillary line (Fig. 2). Pneumothorax of 4–8 mm Hg was established during surgery. After mobilization of the inferior pulmonary ligament, the endoscope was introduced through the mouth, and the location of the stenosis was identified. The stenotic site was about 2 cm proximal to the diaphragm. The area of esophageal stricture...
was circumferentially dissected with sparing of both vagus nerves and encircled with vessel tape. With traction of the vessel tape, the esophageal dissection was extended close to the diaphragm distally and 4 cm proximally from the stenotic site. Several stay sutures were placed at the cut line of the esophagus, and diamond-shaped partial resection of the esophageal wall was carried out using scissors with electrocautery (Fig. 3A). The length of the resected stenotic segments was about 2.0 × 1.5 cm. After placing a nasogastric tube, a transverse closure was carried out using 5 interrupted 4-0 absorbable sutures (Fig. 3B). Finally, a chest tube was placed through the port site. Histologic examination of the resected specimen revealed fibromuscular thickening and fibrosis. A minor leakage was observed postoperatively for 4 days, but this stopped with conservative treatment. One month after surgery, balloon dilatation was performed due to slight stenosis at the anastomotic site, revealing an easily dilatable stenosis. The postoperative esophagogram showed good results with smooth passage of barium. The patient is asymptomatic and eats normally 5 years after surgery.

1.2. Case 2: 13-month-old boy with CES at the level of T10 due to TBR

Partial esophageal resection and transverse anastomosis followed by anterior partial fundoplication by a laparoscopic approach were performed for stenosis at the level of T10 (Fig. 1B). Under general anesthesia, the patient was placed in the supine position. Before surgery, an esophageal balloon dilator was placed via a nostril into the esophagus to determine the stenotic segment of the esophagus during surgery. Four 5-mm ports were used in

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**Fig. 1.** A) Esophagogram in case 1 showing a stenosis at the level of T9. B) Esophagogram in case 2 showing a stenosis at the level of T10.

**Fig. 2.** Port placement in case 1.

**Fig. 3.** Case 1. A) Diamond-shaped partial resection of the esophageal wall across the stenotic site (arrow). B) The esophagus was closed transversely with 5 interrupted 4-0 absorbable sutures (arrow head).
the umbilicus for the 5-mm 30° scope, the right and left epigastric regions, and the left lateral region. Pneumoperitoneum of 10 mm Hg was established. A Nathanson retractor was introduced directly at the subxiphoid region to retract the liver (Fig. 4). First, the esophagus was circumferentially dissected, identifying the posterior and anterior vagus nerves. The hepatic branch of the vagus nerve was not divided. The esophagus was encircled with vessel tape above the hepatic branch of the vagus nerve. By traction of the vessel tape, the hiatus was opened, and further dissection was carried out until enough of the intra-abdominal part of the esophagus was obtained. The lower esophagus was then mobilized for about 5 cm. Next, the balloon was inflated to identify the stenotic site under fluoroscopy. The stenotic site was about 2.5 cm proximal to the gastroesophageal junction. The anterior vagus nerve was mobilized from the esophagus and looped to obtain sufficient excision of the stenosis. Several stay sutures were placed at the cut line of the esophagus. With traction of stay sutures, a diamond-shaped partial resection of the esophageal wall from the 10- to the 3-o’clock position was made across the stenotic site using scissors with electrocautery (Fig. 5A). The stenotic site was noted to be stiff and revealed the presence of cartilage. The length of the resected stenotic segments was about 2.0 × 1.5 cm. A nasogastric tube was placed, and the esophagus was then closed transversely with 6 interrupted 3-0 absorbable sutures (Fig. 5B). The posterior crura were approximated, and the esophagus was secured to the crura at the 10-, 2-, and 5-o’clock positions. Finally, Thal fundoplication was performed to reinforce the suture line and prevent gastroesophageal reflux (GER). Histologic examination of the resected specimen revealed cartilage, tracheobronchial glands, and ciliated epithelium in the esophageal wall. The patient made an uneventful recovery. One month after surgery, balloon dilatation was performed due to slight stenosis, revealing an easily dilatable stenosis. The esophagogram 4 months after surgery showed smooth passage of barium without GER (Fig. 6). The patient is asymptomatic and eats normally 6 months after surgery.

2. Discussion

CES is a rare anomaly and divided into 3 types: TBR, FM, and MW. Generally, the symptoms of vomiting and regurgitation become significant when the patients start semi-solid and solid foods. CES commonly affects the lower esophagus, and the diagnosis is made with esophagography and endoscopy. EUS may be useful to distinguish between TBR and FM by detecting the cartilage [3], but the precise diagnosis is difficult. In many cases, the diagnosis is made by intraoperative findings and histologic study of the resected specimen. Appropriate therapeutic strategies, including endoscopic dilatation and surgical repair, still remain controversial [2–8]. Generally, endoscopic dilatation is attempted first. If ineffective, surgical repair is required. Many surgical procedures, including segmental resection, partial resection, and myectomy of the esophageal wall, have been reported [2–7,13]. The preferred treatment for TBR is resection of the stenotic segment with end-to-end anastomosis. Conventionally, the surgical approach was performed via either laparotomy or thoracotomy, depending on the stenotic site. Recently, minimally invasive surgery using a thoracoscopic or laparoscopic approach has been reported for the treatment of CES [9–12]. Deshpande et al. [10] reported laparoscopic esophagoplasty for TBR. In the present two children with

Fig. 4. Port placement in case 2.

Fig. 5. Case 2. A) Anterior vagus nerve was mobilized from the esophagus and looped (arrow). Diamond-shaped partial resection of the esophageal wall from the 10- to 3-o’clock position was made (arrow head). B) The esophagus was closed transversely with 6 interrupted 3-0 absorbable sutures.
CES, endoscopic esophagoplasty that consisted of a diamond-shaped partial resection of the esophageal wall and transverse closure was performed. A thoracoscopic or laparoscopic approach was chosen depending on the stenotic site. In case 1 of CES at the level of T9, thoracoscopic esophagoplasty was performed. In case 2 of CES at the level of T10, laparoscopic esophagoplasty followed by anterior partial fundoplication was performed. The postoperative esophagogram showed slight stenosis at the anastomotic site in both, but it was easily dilated by balloon dilatation one month after surgery. Anastomotic leakage, anastomotic stricture, and GER are postoperative complications. In the laparoscopic approach, a fundoplication should be performed to prevent not only GER, but also anastomotic leakage. In conclusion, thoracoscopic or laparoscopic partial resection of the esophageal wall and transverse anastomosis are considered effective, less invasive, and safe in the treatment of CES, however, the longer follow-up period is necessary.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Conflict of interest

The authors have no conflict of interest to disclose.

References


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**Fig. 6.** Esophagogram 4 months after surgery in case 2 showing smooth passage of barium without gastroesophageal reflux.