

Original Research

Seventy Cases of Partial Gastric Pull-Up According to the Schärli Technique for Esophageal Replacement in Pediatrics

Martín Rubio, MD¹; Mariano Boglione, MD^{1*}; Carlos Fraire, MD¹; Silvia Takeda, MD¹; Cristian Weyersberg, MD²; Fermín Prieto, MD¹; Marcelo Barrenechea, MD¹

¹General Surgery Division, Hospital Nacional de Pediatría Prof. Dr. Juan P. Garrahan, Buenos Aires, Argentina

²Gastroenterology Division, Hospital Nacional de Pediatría Prof. Dr. Juan P. Garrahan, Buenos Aires, Argentina

*Corresponding author

Mariano Boglione, MD

General Surgery Division, Hospital Nacional de Pediatría Prof. Dr. Juan P. Garrahan, Pichincha 1850, 1245 Buenos Aires, Argentina;

E-mail: boglione@usa.net

Article information

Received: September 27th, 2020; **Revised:** October 22nd, 2020; **Accepted:** October 29th, 2020; **Published:** November 18th, 2020

Cite this article

Rubio M, Boglione M, Fraire C, et al. Seventy cases of partial gastric pull-up according to the schärli technique for esophageal replacement in pediatrics. *Pediatr Neonatal Nurs Open J.* 2020; 7(1): 1-7. doi: [10.17140/PNNOJ-7-131](https://doi.org/10.17140/PNNOJ-7-131)

ABSTRACT

Introduction

Esophageal replacement (ER) is indicated in patients with long gap esophageal atresia (LGEA) or failure of the primary anastomosis. Also, severe caustic or peptic strictures, resistant to conservative treatment with medication and dilations, may require an ER. Numerous techniques with different organs and routes have been described, all with satisfactory results.

Objective

Our objective is to describe the experience obtained with partial gastric pull-up according to the Schärli principles (SGPA).

Materials and Methods

Medical records of patients who required a SGPA between October 1995 to June 2018 were reviewed. The analysis was observational, longitudinal, retro-prospective and descriptive. Epidemiological data, surgical aspects and postoperative complications of the patients were considered.

Results

Seventy ER were performed with SGPA. The indication was esophageal atresia (EA) in 58 cases (44 long gap and 14 failure of the anastomosis), 10 caustic strictures, one peptic stricture resistant to conservative treatment and the other due to a retained foreign body. The age of the ER was on average 2-years and 9-months. The route was: posterior mediastinal (35), retrosternal (29) and transpleural (6); without a thoracic approach in 59 patients. The duration of the procedure was 4.7-hours on average. There were 13 cases of intraoperative complications, 8 cases of pneumothorax, 5 bleeding injuries (3 in the spleen, 1 liver and 1 cervical), and one injury to the cervical trachea. Anastomotic dehiscence was observed in 37 patients (52%), which closed spontaneously after an average of 17.8-days in all except one patient. Thirty-one patients (44%) developed anastomotic stenosis, requiring redo anastomosis in 6 cases; 37% developed dumping and 23% gastroesophageal reflux disease. There were 3 deaths (4.2%): all in EA patients with associated malformations, following a morbid postoperative period with infectious complications in intensive care at 10-days, 7 and 8-months after ER. Follow-up was an average of 8-years. All 67 living patients are currently tolerating oral feeding.

Conclusion

In our experience with ER using SGPA, we observed a high incidence of complications, generating a longer post-operative evolution and with greater morbidity than that described in other techniques. Given these results, we changed our strategy to complete gastric transposition, in order to reduce morbidity and improve the evolution of this complex group of patients.

Keywords

Esophageal replacement; Partial gastric pull-up; Esophageal atresia; Caustic stricture.

BACKGROUND

The resolution of complex esophageal atresia (EA) and esophageal strictures that are resistant to conservative treatment with dilations is challenging and remains controversial. Although, it is widely accepted in the literature that the esophagus itself is the best option for complex esophageal pathologies,^{1,2} there are certain circumstances in which loss of the organ is unavoidable and esophageal replacement (ER) is necessary. The ideal esophageal substitute should conform in function as far as possible to the original structure.³ The patient should be able to swallow normally and experience no reflux symptoms.⁴ An additional requisition in children is that the substitute should continue functioning for many decades without deterioration.⁵ There is no perfect method for esophageal replacement due to the complexity of its reconstruction. Satisfactory results have been published with different organs and routes, all with both immediate and long-term complications; although the numbers reported are small, and long-term results are scarce.³⁻⁶

Most of the indications for ER are long gap esophageal atresia (LGEA) or severe anastomotic complications that end in the loss of the organ; and caustic (CS) or peptic strictures resistant to conservative treatment with medication and periodic dilations.^{5,6}

In 1992 Schärli⁷⁻⁹ described a technique that allows the preservation of the lower esophagus and the cardia, with mobilization and elongation of the stomach by means of an incision in the lesser gastric curvature and the ligation and section of the stomachic coronary artery, called partial gastric transfer with preservation of the cardia and distal esophagus.

The objective of this report is to analyze the evolution of a group of patients with complex esophageal pathology, in which we used an ER with partial gastric pull-up according to Schärli's principles (SGPA).

MATERIALS AND METHODS

Medical records of all patients who received a SGPA at Hospital Prof. Dr. Juan P. Garrahan between October 1995 and June 2018 were reviewed. The analysis was observational, longitudinal, retrospective and descriptive. The following epidemiological data were analyzed: sex, underlying disease and reason for replacement, anatomical types of EA, associated malformations (only in the EA group), number of surgical procedures prior to ER, previous thoracotomies, and age at the time of ER. The surgical procedure was recorded: method used (conventional or video-assisted), intra-operative complications, use of thoracic approach, esophagectomy (in the CS group) and procedure duration (in hours). The following data were taken from the post-operative period: days of mechanical ventilation (MV), days of hospitalization in the intensive care unit (ICU), days of total hospitalization and the start of oral feeding.

Early post-operative complications such as anastomotic leakage, and late post-operative complications such as anastomotic stenosis, airway fistulas, gastroesophageal reflux disease (GERD), and dumping syndrome were investigated. Gastric necrosis, num-

ber of reoperations (related to the ER procedure), death, and follow-up in years were also considered. Enteral feeding status was verified at the time of this review. We define dehiscence of the anastomosis by observation of saliva through the cervical wound or leakage of contrast material during esophagogram. We consider stenosis of the anastomosis to be an area of reduced caliber in the esophagogram, requiring at least one esophageal dilation; whether or not it is associated with dysphagia. Dumping syndrome was diagnosed by the development of recurrent postprandial abdominal pain and distention, diarrhea, sweating, paleness and drowsiness, for a period of at least three months. This was always confirmed by abnormal oral glucose tolerance test. GERD is diagnosed by upper gastrointestinal endoscopy in post-operative controls, when observing signs of esophagitis. The digestive fistula to the airway is diagnosed with respiratory symptoms during oral feeding, with an esophagogram and confirmed with respiratory endoscopy.

Pre-Surgical Preparation

Before ER, the patient should be stimulated with "sham feeding" (oral feeding with exit of the material ingested through the cervical esophagostomy), from the moment the patient presents esophagostomy, to facilitate the initiation of oral feeding in the immediate post-operative period. In patients with a diagnosis of EA, a pre-surgical computed tomography angiography of the upper thorax and cervical region is performed, to investigate the presence of previously undiagnosed vascular rings, and in case they are, choose for the retrosternal pull-up route (RER) to perform the ER, avoiding the posterior mediastinal route (PMR). For positioning the patient, we use transverse enhancement in the thoracoabdominal junction and another cervical one, hyperextending the neck, to achieve a good exposure of the cervical esophagus and the esophageal hiatus, and align the mediastinum. A plastic tube can be left in place as a tutor during removal of the esophagostomy. The operative field must involve both the abdomen and the cervical region, as well as the thorax.

Abdominal Step

Through a median supraumbilical incision, the left lobe of the liver is mobilized and adhesions to the gastrostomy area (GTI) are released, removing it and neatly closing it in two planes. The cardia and hiatus are exposed to free the lower esophagus, which is dissected blindly and bluntly into the posterior mediastinum until it is brought into the abdomen in cases of EA and up to the maximum possible height in CS. The stomachic coronary artery (left gastric artery) is ligated after giving its second gastric branch, which allows it to gain 2-3 cm in length, the lesser curvature of the lesser omentum is released from the pylorus to the diaphragmatic hiatus, and the adhesions to the body and gastric fundus are freed with preservation of posterior gastric vessels and short vessels. In this way, the gastroesophageal junction can be mobilized outside the abdominal incision. According to the principles of Schärli,^{7,8} a cutting linear mechanical suture is placed in the lesser curvature, perpendicular or oblique to the stomach¹⁰ (achieving better gastric tubulization). Then, a thick probe is introduced in the created gastric tube, to ensure its adequate caliber. Mechanical suture is reinforced

with resorbable seromuscular imbricating plane stitches.

Section of the lesser curvature allows to mobilize the esophagus and the cardia about 4-6 more centimeters (twice the length of the mechanical shot). If the distal esophagus loses vitality or is very small, it is resected and the anastomosis is performed over the cardia. In case of using the PMR, it is dissected from the esophageal hiatus towards the proximal, in a blunt and blind way until reaching the tracheal carina, in front of the vertebral column. If it is a CS, the esophagus will be freed on all sides in order to resect it. If the decision is made to perform RER, the esophageal hiatus is closed with separate non-absorbable sutures. A tunnel is carved immediately below the xiphoid, following the posterior aspect of the sternum, advancing towards the suprasternal hollow as much as possible. Kocher's maneuver is performed to obtain maximum mobility of the pylorus to pull-up the stomach with the least possible tension. We did not perform pyloromyotomy or pyloroplasty or anterior partial fundoplication to restore the angle of the patient.

Cervical Step

The esophagostomy is disassembled and the proximal esophagus is freed 3-4 cm, taking care not to injure the cervical nerve bundle or the recurrent laryngeal nerve. The dissection of the esophagus should be close to its wall without perforating or devitalizing it. In the PMR, using blunt dissection, a path is made between the posterior aspect of the trachea (membranous) and in front of the prevertebral fascia, creating a tunnel with entrance to the posterior mediastinum (native esophagus route). The same maneuver is performed through the esophageal hiatus between the posterior cardiac aspect and the prevertebral plane simultaneously to unify the tunnel. In cases of CS, esophagectomy is performed. In RER, a space is created immediately behind the sternum following its posterior aspect in an abdominal direction. Special care is taken in not injuring the innominate vascular bundle. To avoid compression, the sternoclavicular muscle attachments can be released. Once the continuity of the tunnel is established, it must be widened so that it is occupied by the thickness of at least two fingers.

Reconstruction

A rubber catheter or Nelaton® catheter with vaseline jelly is placed through the tract, either using the PMR or RER, and the abdominal end of the catheter is attached with two points to the distal esophagus or cardia (if the distal esophagus was resected). They are identified with two sutures of different lengths, to ensure adequate gastric pull-up, avoiding torsion of the organ. From the cervicotomy, delicate traction of the probe is performed, guiding it from the abdomen, to ensure an adequate pull-up. The esophago-esophageal or esophagocardial anastomosis is performed in a full-wall plane with separate absorbable suture stitches in the neck. When finishing the posterior layer, a nasogastric tube is placed, to help finalize the anastomosis and avoid acute gastric distention in the immediate post-operative period. A rubber drainage is left in the cervical wound. In PMR, the ascended stomach is fixed to the diaphragmatic hiatus with non-absorbable suture to avoid her-

niations of abdominal organs towards the thorax and in RER it is anchored to the surrounding tissues. In those patients in whom a sufficient portion of the abdominal stomach remains after performing the ER, we perform a GTT, as described by Schärli, with placement of a gastrojejunal tube; and in those in which this is not possible due to the lack of an adequate gastric reservoir in the abdomen after pulling it up, we perform a feeding jejunostomy for the first post-operative days, until complete oral nutrition is established. If the use of the transpleural pull-up route (TPR) is necessary, it is performed through a classic thoracotomy. In patients with video-assisted approach, the same steps performed in conventional surgery are reproduced using five working paths; one umbilical 10 mm port for the optics, another of 10 mm in the right upper quadrant for mechanical suture introduction, and 3 ports of 5 mm: left, subxiphoid and left flank, similar to the laparoscopic Nissen fundoplication approach. Vascular sealant (Ligasure®) is used to treat the vessels. The mediastinal esophageal dissection is performed under direct vision (mediastinoscopy) until reaching the cervical area through the prevertebral plane. The gastric lesser curvature is sectioned with a cutting linear mechanical suture according to the technique. The stomach is guided towards the neck under laparoscopic control.

Post-operative Management

An oral esophagogram is performed, starting on the seventh post-operative day to detect early complications. If there is no leakage of the contrast material and there is good distal passage, the cervical drain and nasogastric tube are removed and oral feeding is started. Long-term esophagograms allow finding late complications.

RESULTS

Seventy SGPA were carried out in a 22-year period. Thirty-five patients were male. The indications were EA in 58 cases (82.8%), CS in 10 cases (14.2%), GERD in 1 case (1.5%) and the remaining was a case of retained foreign body (1.5%). Within the EA group, 44 were long gap ends (absence of the esophagus) and 14 were anastomotic failure (esophageal loss). In all cases of CS, the indication for ER was recurrent stenosis after conservative treatment with periodic dilations, as in the patient with peptic stenosis. The anatomical types in the EA group were: type I 29 (50%), II 2 (3.4%), III 24 (41.4%) and IV 3 (5.2%). Fifty percent of the EA's (29/58) had associated malformations, most of them cardiovascular. Regarding the number of surgical procedures prior to ER, an average of 2.7 procedures was performed per patient (0-8). Forty-two percent of the patients had thoracotomies prior to ER (12 of them had 2 thoracotomies, and 2 patients had 3). The average age at the time of ER was 2-years and 9-months (2-months. 18-years). The method used for the SGPA was conventional in 66 cases and video-assisted in 4 (two of which were converted due to the presence of severe adhesions). In one case, thoracoscopy was used to perform the anastomosis. The routes used were: 35 PMR (50%), 29 RER (41.4%) and 5 TPR (8.6%).

Thirteen patients (18%) presented intraoperative complications: 8 pneumothorax (4 bilateral, 2 right and 2 left), which were

drained in the operating room; 5 bleeding injuries: 3 splenic, one hepatic when dismantling the GTT from surrounding adhesions, and one cervical vascular injury, when a tributary branch of the jugular vein was injured. All of these were resolved with hemostatic suture. A patient with a splenic lesion also presented a punctate perforation in the cervical trachea during esophagostomy release, which was sutured with two separate stitches of non-absorbable material. The thoracic approach was used in 11 cases (15.7%): 9 thoracotomies as the first surgical procedure (4 in CS to perform esophagectomy, 3 in EA to evaluate the possibility of anastomosis, and 2 in EA to close a tracheoesophageal fistula). One thoracotomy was necessary after the abdominal approach for esophageal release, and other thoracoscopy was approached for intrathoracic anastomosis of the ER. Esophagectomy was performed in 9 of the 10 cases of CS. The esophagus was left abandoned in only one patient due severe adhesions to the vascular elements of the mediastinum. The mean ER duration was 4.7-hours (3-10). All cases were post-operatively managed in the ICU. Hospitalization data is summarized in table N°1 (Table 1).

Table 1. Hospitalization Data

	Days	Range
ICU	17	3-241
MV	11	0-240
Total	42	10-241
Oral intake	22	7-65
ICU: intensive care unit		
MV: mechanical ventilation		

As early post-operative complications, anastomotic dehiscence was evidenced in 37 cases (52.8%). Thirty-six closed spontaneously in an average of 17.8-days (4-69). Only in one case surgical closure was needed. Closure was performed at 39-days, being one of the first cases in the series. Late complications reported 31 stenoses of the anastomosis (44%). Of the 31 strictures, 21 (68%) had previous history of dehiscence. All were treated with dilations, with an average of 4.2 dilations per patient (1-14). Six patients required resection of the stenosis and redo anastomosis due to failure of conservative management with dilations (one of these 6 required a second redo). Two ER by PMR with primary diagnosis of type III EA (whose primary anastomosis failed evolving with dehiscence and dehiscence plus tracheoesophageal refistula) presented fistula from the ER to the airway, which were treated surgically to separate the airway from the digestive tract. One of them required a pneumonectomy. Twenty-three percent (16/70) had signs of GERD in the post-operative endoscopic digestive controls that were successfully managed with increased doses of proton pump inhibitors and dietary measures. Thirty-seven percent of the cases (26/70) presented dumping syndrome, reversing their symptoms with a feeding of raw cornstarch and suspension of simple carbohydrates. One patient with long gap type III EA who underwent an ER by PMR presented severe digestive hemorrhage with hemodynamic decompensation, product of a fistula of the right carotid artery to the cervical anastomosis. The child had an undiagnosed right subclavian artery arising from the aortic arch as a last branch. Successful emergency surgical treatment was

performed. There were no cases of gastric necrosis. Ten patients were reoperated (14%): 6 redo anastomosis due to stenosis; 2 fistula closure to the airway (one underwent right pneumonectomy, and in the same patient a hiatoplasty was also performed due to hiatal hernia later on); one esophagocutaneous fistula closure; and one emergency cervical arterioesophageal fistula closure. There were three deaths in our series (4.2%): the first patient was a type III EA III (with associated renal malformation) who presented a dehiscence after the anastomosis, was replaced by PMR and underwent a torpid post-operative period in the ICU after ER due to dehiscence of the anastomosis and stenosis, fistula to the airway that required surgery for its closure (with right pneumonectomy) and another surgery for hiatal hernia, who died 7-months after RE in the context of sepsis with multiple failure. The second one was a long gap type III EA (with associated cardiac and anorectal malformation) that was replaced by RER who died in the ICU 10-days after surgery due to mediastinitis with respiratory distress, active pulmonary bleeding, sepsis by acinetobacter Baumannii and a respiratory syncytial virus. The third one was a long gap type I EA associated with Down syndrome and congenital heart malformation that died 8-months after ER by to RER that evolved with stenosis, which required a series of dilations (without complications) and a tracheostomy because of prolonged intubation. He died of sepsis caused by central venous catheter related infection due to methicillin-resistant *Staphylococcus aureus* following a post-operative period with multiple infections to other resistant germs. This patient had severe pulmonary hypertension caused by a restrictive ostium secundum atrial septal defect and grade II pericardial effusion. Mean follow-up for the series was 8-years (18-months . 18-years). Four patients (5.9%) were lost of follow-up. The 67 living patients are currently tolerating the oral intake, with complementary nutritional support by gastrostomy in 16 cases.

DISCUSSION AND CONCLUSION

Most authors agree that the patient's native esophagus is better than any possible organ used for replacement.^{1,2} While this might be theoretically true, the persistent efforts to preserve the native esophagus can be associated to innumerable complications such as multiple operations, mediastinitis, recurrent tracheoesophageal fistulas, long and stubborn strictures, prolonged hospitalizations, nutritional compromise, and pulmonary sequelae, among others, which in turn may lead to the preservation of a completely dysfunctional esophagus. Beginning in 2009, several authors^{11,12} started to consider the possibility of performing an early ER, in order to reduce the morbidity associated to the prolonged efforts to preserve the esophagus at all costs. The ideal cases to which this idea could be applied were complex EA cases, but it could expand to patients with long or multiple caustic or peptic strictures resistant to conservative management.^{9,12} The goal was to reduce the morbidity and mortality associated to the attempts to preserve the native esophagus by doing an early ER, ideally between 8 and 12-months of age.⁵ The mean age at ER in our study was 2.75-years. As there is no ideal substitute for the esophagus, different techniques with their advantages and disadvantages have been published, both for the organ and the chosen route, such as colonic,³ jejunal⁴ interposition; total gastric pull-up,⁵ or partial gastric tube,⁶ including the Schärli technique, sectioning the lesser gastric

curvature.^{7,8} All of them reproducible and with satisfactory results, both in the short and long-term.¹⁰⁻¹² In our department we chose the stomach as the first option for ER, since it is a more uncomplicated technique since it requires a single anastomosis, it reaches the cervical area without major difficulties and also presents excellent vascularization, a fact demonstrated in our series of 70 patients without any case of gastric necrosis. When choosing the stomach, a decision must then be made between a technique that uses the entire stomach⁵ or only a partial form of it.^{6,7}

Unlike what is described by Schärli, we did not perform pyloromyotomy or pyloroplasty (due to the high percentage of dumping), or anterior partial fundoplication to restore the his angle (since the fundoplication only works correctly when the anatomy of the gastroesophageal junction is preserved). Schärli also does not use PMR or TPR or video-assisted techniques for ER. That's the reason we say that our experience follows "the principles" of Schärli, since we do not reproduce exactly the technique described by him. We modified the orientation of the lesser curvature section with mechanical suture¹⁰ (oblique shape), to better tubulize this gastric segment so that it is not so dilated in the thorax. Furthermore, it was not always possible to perform a GTT as described by the author, since in many cases we noticed the lack of an abdominal gastric reservoir after SGPA, so we performed a feeding jejunostomy in those cases. Also in some cases, we resect the lower esophagus because it is very rudimentary or is devascularized after dissection, performing the anastomosis directly to the cardia. We not only use this technique in patients with a diagnosis of long gap EA, but also extend the indication in those where the anastomosis failed, in caustic and peptic strictures cases, and in retained foreign body sequelae. Our complications, 52.8% dehiscence and 44% stenosis, were higher than other series consulted, regardless of the technique used, when compared with the use of the colon³ (29 and 13.1%), jejunum⁴ (0 and 27%), total gastric pull-up⁵ (12 and 19.6%), and gastric tube⁶ (9.5 and 9.5%). Two of these series even refer 2.9%⁵ and 9.5%⁶ of dumping, against 37% in our series. The large number of complications of the anastomosis can be explained by the fact that the gastric section interrupts the submucosal supply and contributes to the vascular problems of the anastomoses that trigger leakages and strictures. This could be minimized by performing a total gastric transposition with anastomosis to the gastric fundus.⁵ Supporting our findings, Kudo and collaborators¹³ studied the gastric parietal vascular flow with laser Doppler velocimetry and demonstrated in an adult population that the flow is significantly better in the gastric wall in the total gastric pull-up, than in the gastric tubes that suffer wall section. Although we learned that spontaneous resolution of dehiscence occurs in a very high percentage (97.3%) and the management of stenosis is successful in most cases through serial dilations (80.6%), the consequences of the high percentages of complications increase the number of days of hospitalization and delay the times for our patients to acquire complete oral feedings intake. The large amount of dumping could be explained by the modification of the gastric reservoir. It could be assimilated to the dumping observed in the post-operative period of other surgeries, where the gastric reservoir is also reduced, such as antireflux surgery, in cases of GERD,¹⁴ and bariatric surgery, in obese patients.¹⁵ Partial gastric pull-up cases have a smaller gastric reservoir since part of it is tubulized to

form the neoesophagus. All cases of dumping had a good response to dietary management, however they prolonged weight and height gain in these patients, in addition of having bothersome symptoms when eating. Comparative studies between total and partial gastric replacement techniques show similar results, both in children¹⁶ and in adults.¹⁷ These last authors conclude that increasing gastric capacity and maintaining the submucosal vascular network provide better results using the entire stomach. The two fistulas to the airway occurred in patients with a history of type C EA in whom we used the PMR route. In both patients, a primary anastomosis was done initially, but was followed by dehiscence and refistula with the subsequent loss of the native esophagus. In these cases, the PMR is more complex, because it is performed blindly blunt on a territory with scars from previous surgeries and complications from anastomosis, and it is closely related to other important organs. This would explain that both cases occurred using the PMR. Fistula from the ER to the airway is a serious complication, which requires aggressive surgery (one of them required pneumonectomy and later died), and which should be prevented by overlapping the mechanical suture, although the same occurred in these cases, despite the fact that we always do the nesting. Other ways to avoid a fistula to the airway would be using a total stomach ER technique⁵ (which does not contain a long suture in the mediastinum, a fact that could predispose to communication with the airway, and that only presents the suture of the closure of the GTT); or using RER, at least in cases with a diagnosis of EA with fistula. We have already demonstrated¹⁸ that PMR without thoracotomy was safe for us without severe complications, despite the fact that most of our cases had several previous thoracic surgeries, and we prefer it because it is the shortest and straightest route. Aorto-esophageal fistula is a rare cause of gastrointestinal bleeding, usually fatal. It can be acquired due to the presence of a suture in the aorta in contact with the esophagus, as in cardiovascular surgeries; or congenital in cases of vascular rings, associated with prolonged mechanical ventilation and nasogastric tube.^{19,20} One patient in the series (EA III) with ER by PMR presented in the post-operative period a severe gastrointestinal bleeding with hemodynamic decompensation, due to a fistula of the right carotid artery to the cervical anastomosis.²¹ The child had an undiagnosed right last branch subclavian artery (aberrant right subclavian artery). He had a successful emergency operation. From this case on, we perform a preoperative computed tomography angiography to rule out vascular rings in patients with EA and, if present, RER is used. There are many publications describing aorto-esophageal fistulas, but we believe this is the first case described as a complication in the post-operative period of an ER. This complication should be quickly suspected in a post-operative period that presents with digestive bleeding of bright red blood, associated with prolonged tracheal and nasogastric intubation. Immediate exploration is recommended to avoid fatal outcome. The development of minimally invasive methods has made it possible to solve this group of complex patients in a satisfactory way. We use laparoscopy and mediastinoscopy to achieve dissection under vision like other authors²²⁻²⁴ in four patients, two were converted to conventional surgery because they found severe esophageal adhesions when performing the PMR. Video-assisted surgery reproduces the steps of the conventional procedure, with the advantage of performing an esophageal dissection under direct vision (mediastinoscopy) using precise and

delicate maneuvers, unlike blunt and blind maneuvers. It is a feasible and reproducible alternative in trained centers, but it requires more numerous comparative series to evaluate the results with those of conventional surgery. We believe that the best candidates for this technique are those who do not have previous thoracic surgeries, such as EA I or CS that only received dilations. In our series we had 3 deaths (4.2%), an incidence similar to other series. All occurred as a result of severe systemic infectious complications in the ICU due to resistant germs triggering multiple organ failure and death. All had a history of multiple surgeries and congenital malformations. It is a high percentage of mortality for any type of surgery, but it must be taken into account that ER is a complex surgery in patients having comorbidities. In the literature is not clear which alternative can improve these results. Perhaps morbidity and mortality could be reduced by performing an earlier ER, avoiding unnecessary efforts to retain a diseased esophagus,^{11,12} allowing to perform this procedure in a patient in a better clinical condition. We believe that this is the series with the highest number of cases using the Schärli technique as an ER strategy. We have found in the literature 4 reports using the Schärli procedure, two of them belong to Schärli himself and the other two to different authors. In all of them the authors report a small number of cases. Due to the fact that with our experience in SGPA, we had a high incidence of complications, generating longer post-operative hospital stay and greater morbidity than those described in other techniques; we decided to change it to complete gastric transposition,⁵ in order to reduce morbidity and improve the evolution of this group of patients. However, we believe that the strategy of sectioning the lesser gastric curvature is useful in those patients in whom an extra elongation is necessary to bring the esophageal ends closer allowing to perform an anastomosis under less tension. We consider that it is important to identify those children who require an early ER, to prevent their clinical deterioration. Currently our technique of choice in ER is the total gastric pull-up by posterior mediastinal route.

INSTITUTIONAL REVIEW BOARD

This study does not need approval by the Institutional Review Board since it is a retrospective study.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

- Friedmacher F, Puri P. Delay primary anastomosis for management of long gap esophageal atresia: A meta-analysis of complications and long-term outcome. *Pediatr Surg Int*. 2012; 28: 899-906. doi: [10.1007/s00383-012-3142-2](https://doi.org/10.1007/s00383-012-3142-2)
- Puri P, Ninan GK, Blake NS, Fitzgerald RJ, Guiney EJ, O'Donnell B. Delayed primary anastomosis for esophageal atresia: 18-months' to 11-years' follow-up. *J Pediatr Surg*. 1992; 27: 1127-1130. doi: [10.1016/0022-3468\(92\)90573-p](https://doi.org/10.1016/0022-3468(92)90573-p)
- Ahmad S, Sylvester K, Hebra A, Davidoff A M, McClane S, Stafford P W, et al. Esophageal replacement using the colon: Is a good choice? *J Pediatr Surg*. 1996; 31(8): 1026-1031. doi: [10.1016/s0022-3468\(96\)90078-0](https://doi.org/10.1016/s0022-3468(96)90078-0)
- Platt E, McNally J, Cusick E. Pedicled jejunal interposition for long gap esophageal atresia. *J Pediatr Surg*. 2019; 54(8): 1557-1562. doi: [10.1016/j.jpedsurg.2018.10.108](https://doi.org/10.1016/j.jpedsurg.2018.10.108)
- Spitz L, Kialy E, Pierro A. Gastric transposition in children – a 21 year experience. *J Pediatr Surg*. 2004; 39(3): 276-291. doi: [10.1016/j.jpedsurg.2003.11.032](https://doi.org/10.1016/j.jpedsurg.2003.11.032)
- Borgnon J, Tounian P, Auber F, Larroquet M, Clemen FB, Girardet J P, et al. Esophageal replacement in children by an isoperistaltic gastric tube: A 12-year experience. *Pediatr Surg Int*. 2004; 20: 829-833. doi: [10.1007/s00383-004-1190-y](https://doi.org/10.1007/s00383-004-1190-y)
- Schärli A. Esophageal reconstruction in very long atresias by elongation of the lesser curvature. *Pediatr Surg Int*. 1992; 7: 101-105. doi: [10.1007/BF00178419](https://doi.org/10.1007/BF00178419)
- Schärli A. Esophageal reconstruction by elongation of the lesser gastric curvature. *Pediatr Surg Int*. 1996; 11: 214-217.
- Fernandez M, Gutierrez C, Ibañez V, Lluna J, Barrios JE, Vila JJ, et al. Long-gap esophageal atresia: Reconstruction preserving all portions of the esophagus by Schärli's technique. *Pediatric Surg Int*. 1998; 14: 17-20. doi: [10.1007/s003830050426](https://doi.org/10.1007/s003830050426)
- Beasley S, Skinner A. Modified Schärli technique for the very long gap esophageal atresia. *J Pediatr Surg*. 2013; 48: 2351-2353. doi: [10.1016/j.jpedsurg.2013.08.005](https://doi.org/10.1016/j.jpedsurg.2013.08.005)
- Spitz L. Gastric transposition in children. *Semin Ped Surg*. 2009; 18: 30-33. doi: [10.1053/j.sempedsurg.2008.10.006](https://doi.org/10.1053/j.sempedsurg.2008.10.006)
- Ron O, De Coppi P, Pierro A. The surgical approach to esophageal atresia repair and the management of long-gap atresia: Results of a survey. *Semin Ped Surg*. 2009; 18: 44-49. doi: [10.1053/j.sempedsurg.2008.10.009](https://doi.org/10.1053/j.sempedsurg.2008.10.009)
- Kudo T, Abo S, Itabashi T. Prognosis of esophageal substitute in tissue viability and anastomotic leakage. In: Siewert JR, Hölscher AH, eds. *Diseases of the Esophagus*. Berlin, Heidelberg: Springer; 1988: 522-525. doi: [10.1007/978-3-642-86432-2_119](https://doi.org/10.1007/978-3-642-86432-2_119)
- Samuk I, Afriat R, Horne T, Bistrizter T, Barr J, Vinograd I. Dumping syndrome following Nissen fundoplication, diagnosis, and treatment. *J Pediatr Gastroenterol Nutr*. 1996; 23(3): 235-240. doi: [10.1097/00005176-199610000-00006](https://doi.org/10.1097/00005176-199610000-00006)
- van Beek A., Emous M., Laville M, Tack J. Dumping syndrome after esophageal, gastric or bariatric surgery: pathophysiology, diagnosis, and management. *Obes Rev*. 2017; 18: 68-85. doi: [10.1111/obr.12467](https://doi.org/10.1111/obr.12467)
- Tannuri U, Tannuri ACA, Goncalves M, Cardoso SR. Total gastric transposition is better than partial gastric tube esophagoplasty

for esophageal replacement in children. *Dis Esophagus*. 2008; 21: 73-77. doi: [10.1111/j.1442-2050.2007.00737.x](https://doi.org/10.1111/j.1442-2050.2007.00737.x)

17. Collard J, Tinton N, Malaise J, Romagnoli R, Otte JB, Kestens PJ. Esophageal replacement: Gastric tube or whole stomach? *Ann Thorac Surg*. 1995; 60: 261-267. doi: [10.1016/0003-4975\(95\)00411-d](https://doi.org/10.1016/0003-4975(95)00411-d)

18. Rubio M, Barrenechea M, Boglione M. y col. Reemplazo de esófago con estómago por vía mediastinal posterior sin toracotomía. *Rev Cir Inf*. 2019; 21-28.

19. D'Angelis A, Questa H, Prieto F, Laundryc L, Charroqui A. Successful surgical treatment of a 4-month infant after exanguination for aortoesophageal fistula. *J Pediatr Surg*. 2006; 41: 848-849. doi: [10.1016/j.jpedsurg.2005.12.026](https://doi.org/10.1016/j.jpedsurg.2005.12.026)

20. Flores J, Shiya N, Kuniyara T, Yoshimoto K, Yasuda K. Aortoesophageal fistula: Alternatives of treatment. case report and literature review. *Ann Thorac Cardiovasc Surg*. 2004; 10(4): 241-246.

21. Rubio M, Boglione M, Barrenechea M. Fístula arterioesofágica: complicación en un paciente con atresia de esófago de cabos distantes con ascenso gástrico parcial. *Rev Cir Inf*. 2019; 41-46.

22. Shalaby R, Shams A, Soliman SM, Samaha A, Abdelrazek Ibrahim H. Laparoscopically assisted transhiatal esophagectomy with esophagogastroplasty for post-corrosive esophageal stricture treatment in children. *Pediatr Surg Int*. 2007; 23: 545-549. doi: [10.1007/s00383-007-1888-8](https://doi.org/10.1007/s00383-007-1888-8)

23. Stanwell J, Drake D, Pierro A, Kiely E, Curry J. Pediatric laparoscopic-assisted gastric transposition: Early experience and outcomes. *J Laparoendosc Adv Surg Tech*. 2010; 20: 177-181. doi: [10.1089/lap.2009.0062](https://doi.org/10.1089/lap.2009.0062)

24. Rubio M, Cabral S, Farire C. Abordaje por laparoscopia del mediastino posterior para esofagectomía y ascenso gástrico. *Rev Cir Infantil*. 2013; 109-115.