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ORIGINAL ARTICLE

Early complications with colon esophageal substitution for children via retrosternal

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Abstract

Objective: *to describe the early complications of esophageal replacement with colon in children.* **Methods:** *Descriptive cross-sectional study from 2005 to 2011 in pediatric patients diagnosed with alkali intake, esophageal atresia or esophageal injury traumatic esophageal replacement handled via retrosternal colon. Descriptive statistical analysis using SPSS 20.0.* **Results:** *We included 19 esophageal replacements, age seven (4-15), 13 (68%) male and six (31%) female. Initial diagnosis of ingestion of caustic 13 patients (68%) and type III esophageal atresia six cases (32%). Of the six esophageal atresia, four (66%) had dehiscence plasty, one (17%) long-gap atresia and type 1 (17%) esophageal perforation by dilatation. The segment of transverse colon was used in eight (42%), transverse/descending seven (36%), ascending/transverse three (15%), and descending colon one (5%). Early complications were pneumothorax one patient (5%), pneumonia three (15%), sepsis three (15%), intestinal obstruction due to adhesions two (10%), intussusception one (5%), cervical fistula three (15%). One death from sepsis (5%) at four days after surgery.* **Discussion:** *Esophageal replacement with colon is a good alternative for esophageal replacement; the most frequent early complications were cervical fistula, pneumonia, and sepsis.* (Gac Med Mex. 2015;151:301-5)

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Introduction

Esophageal replacement is a surgical technique that is indicated when the native esophagus is unable to serve as a conduit between the larynx and the stomach. In the pediatric population, the main indications for esophageal replacement include: long-gap esophageal atresia when primary anastomosis is unlikely, esophageal atresia with anastomotic dehiscence requiring esophagostomy, prematurity or respiratory distress precluding primary anastomosis, severe anastomotic stenosis unresponsive to dilatations, esophageal strictures due to caustic ingestion not responsive to dilatation and gastroesophageal reflux stenosis[1,2].

The first report on an esophageal replacement took place in 1877; it was performed by Czerny M using a subcutaneous skin tube over the sternum in an adult. This tube was also used by Ladd and Gross in children with long-gap esophageal atresia, but this technique soon became obsolete when intrathoracic surgery techniques emerged for the management of the esophagus,

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which allowed for improved safety[2]. Several tissues have been used for esophageal replacement, such as the colon, stomach and jejunum, but the colon is the most popular surgical option[1]. The use of the colon was first reported by Lundblad O in 1921, who successfully interposed the colon between the cervical esophagus and the stomach in a 3-year old child diagnosed with caustic stenosis. In 1955, Dale WA and Sherman CD described the retrosternal technique for colonic pull-up; two years later, Sherman CD and Waterson DW described the posterior mediastinal route; in both procedures, the main complication was the formation of a cervical fistula[3,4]. Three routes have been recommended for pulling the graft up: transthoracic, mediastinal and retrosternal; the first two have the advantage of lower incidence of graft redundancy, but there is always danger of contaminating the cavity in case of graft necrosis. The retrosternal route has the advantage of being technically simple, since it avoids the need for thoracotomy, the graft remains protected and, in addition, the risk of contamination in case of necrosis is eliminated; it is also recommendable in patients with a history of caustic ingestion, where the thoracic approach is hindered by fibrosis at the mediastinum occurring in these patients[3,5].

Regardless of the technique used in esophageal replacement, complications have been frequently observed: early complications occur within the first month post-surgery, with late complications occurring after more than a month but before one year post-surgery and long-term complications occurring more than one year after surgery[1].

In the world literature, early complications have been reported to be likely to occur in 53% of patients after colonic interposition surgery, with the most common being cervical fistula and anastomotic stenosis, pneumothorax, pneumonia, pleuritis, gastrocolic reflux and sepsis[1,6]. According to the literature, the incidence of cervical fistula and coloesophageal anastomosis stenosis can be as high as 60%[7,8].

The factors that influence on this high incidence of fistula or stenosis include poor blood irrigation supply to the esophagus and the colon, absence of protective omentum, lack of esophageal serosa and the friable nature of the tissue. There are studies that have demonstrated that the use of fibrin sealants reduces the risk of cervical fistula[9,10].

The purpose of this study was to describe early postoperative complications of esophageal replacement with colon transposition using the retrosternal route in children.

Material and methods

Design

Cross-sectional, descriptive study conducted between January 2005 and December 2011 at the Esophagus Clinic of the High Specialty Medical Unit, Pediatrics Hospital, Centro Medico Nacional de Occidente, in Guadalajara (Mexico).

Patients

Patients diagnosed with alkali ingestion, esophageal atresia or traumatic esophageal lesion were included. Children of any age and gender, in the post-operative period after esophageal replacement surgery with colon transposition using the retrosternal route, were considered; post-operative pediatric patients after esophageal replacement with gastric pull-up were excluded; and patients with incomplete medical records were eliminated.

Study description

Esophagus Clinic databases were searched for patients with established diagnoses who met the inclusion criteria. A review was conducted of post-operative patients' physical and electronic records. The case report form included eight sections with relevant data of interest, where the most important early post-surgical complications were identified. The data were fed into an electronic data base and the corresponding statistical analysis was carried out.

Description of the technique

Pre-operative management

Once the patient was selected for esophageal replacement, he/she was admitted 6 days prior to the procedure for pre-operative exams and preparation of the colon, as well as to confirm the absence of aggregated infection. The two first days, the patient was maintained on a liquid diet, and albendazole 5 ml was given via gastrostomy tube or oral route only for 2 days, together with nystatin 200,000 IU to the oral cavity q/8 h. Then, fasting was started until the day of surgery, with solutions calculated according to basal requirements per kilograms of weight or body surface area in square meters. Preparation of the colon was started with evacuant enemas with 0.9% saline (30 ml/kg/dose), adding neomicin to the enema every 12 h

(50 mg/kg/day), as well as irrigations with polyethylene glycol via gastrostomy tube at 10-15 ml/kg/h until the patient produced clean evacuations. Antibiotics for gram-negative organisms, such as intravenous amikacin and metronidazole were added. Twenty-four hours prior to the procedure, a pre-anesthetic assessment was performed and packed red blood-cells, platelet concentrates and fresh-frozen plasma units were typified.

Surgical technique

Once the patient has been intubated, peridural anesthesia is applied for post-surgical anaglesia; after asepsis and antisepsis measures have been established, a 2 or 3-lumen central venous line is installed with the right subclavian approach, in addition to vesical catheter, nasogastric tube or mouth dilator to facilitate esophageal dissection (Malloney or Hurst). The patient is placed with the thoracic base elevated at 20° and the neck in extension, right or left laterally, depending on the site of esophagostomy. Antisepsis of the patient includes the chin, the thorax, lateral parts, the entire abdomen and the medial portion of the thighs. If two surgical teams are available, cervical approach is started with dissection of the esophagus and the abdominal approach at the same time through a supra- and infraumbilical midline incision.

Then, the gastrostomy is detached from the abdomen and a meticulous dissection of the left or right retrosternal space is performed to form the tunnel through which the colon to be pulled up will pass. The left sternoclavicular junction is approached with a broad dissection respecting the jugular and the carotid, partial resection of the clavicule-sternon juncture is performed to prevent twisting of the colon at that level and esophagocolic anastomosis is performed: plasty of the mucosa, with continuos absorbable suture, and muscular plasty, with non-absorbable suture and separate stitches; a subcutaneous penrose is left at the site of anastomosis, and later, gastrocolic anastomosis is performed with continuous absorbable suture separating the muscular tissue with non-absorbable suture and, finally, the colo-colonic anastomosis is performed with absorbable suture in a single plane and with separate stitches. At the end of the surgery, the patient is transferred to the Pediatric Intensive Care Department, intubated and sedated with amines if necessary and with very close monitoring for post-operative management until his/her general conditions allow for management in the hospitalization area.

Statistical analysis

This was a non-probabilistic sampling of consecutive cases. Descriptive statistics with frequencies and percentages was used for qualitative variables, and medians and ranges for quantitative variables. Statistical analysis was performed using the SPSS 20.0 package for Windows.

Sample size

The sample size calculation was made with the formula for a proportion taking into account the complications likelihood rate of this procedure referred in the article by Coopman et al.[1], considering a complication likelihood rate of 53%, a proposed alpha-value of 0.05 and a Z-value of 1.96. Once the formula was applied, it was concluded that a minimum of 15 patients were required to preserve the validity of the study.

Ethical aspects

The guidelines established in the General Health Statute on research for health were observed, as well as the Declaration of Helsinki of the World Medical Association on ethical principles for medical investigations in human subjects. There were no conflicts of interests. The protocol was accepted by the Local Committee on Research and Ethics in Health, with the reference number R-2012-1302-30.

Results

During the studied period, 25 esophageal replacements were performed; out of these, two patients were excluded because the procedure was gastric pull-up and 4 for not having complete medical records. Finally, 19 pediatric patients with colon interposition were assessed.

The most relevant clinical and demographic characteristicas are shown in table 1. More frequency of the male gender was observed, with ages ranging from 4 to 15 years; weight ranged from 11 to 62 kg, height, from 90 to 160 cm, and body mass index (BMI), from 7.5 to 24.2.

Initial diagnosis was caustic ingestion in 13 patients and type III esophageal atresia in 6.

The cause of replacement in the cases of caustic ingestion was esophageal stenosis in 100% of the patients, who failed to respond to established mangement with dilatations. Of the 6 esophageal atresias, in 4 (66%) there was dehiscence of the plasty, in 1 (17%), long-gap atresia, and in 1 (17%), esophageal perforation due to dilatations. The colon segment used was

Table 1. Clinical and sociodemographic characteristics of postoperative pediatric patients after esophageal replacement with colonic interposition using the retrosternal route

Characteristic	Value (n = 19)
Male/female gender, n (%)	13 (68)/6 (31)
Age in months, median (range)	8 (4-15)
Weight in kg, median (range)	23 (11-62)
Height in cm, median (range)	120 (90-160)
BMI, median (range)	14.4 (7.5-24.2)

transverse in 8 (42%) cases, transverse and descending in 7 (36%), ascending and transverse in 3 (15%) and ascending in 1 (5%) (Table 2).

Early complications were: pneumothorax in 1 patient, pneumomia in 3 (occurring at 4 days on average), sepsis in 3 (at 2 days on average), intestinal occlusion due to bridles in 2, intestinal intussusception in 1 and cervical fistula in 3 (at 10 days on average). One death due to sepsis occurred 3 days post-surgery. All patients underwent an esophagram at 7-10 days post-surgery; the start of the oral route ocurred at 9 days on average. Average hospital length of stay was 19 days (Table 3).

Table 4 shows the outcomes of the diagnosed conditions and non-surgical treatment of the children undergoing esophageal replacement with colon interposition using the retrosternal route. The days required for patient preparation are shown, as well as the management of sepsis, post-operative days when the esophagram was taken, days to the occurrence of fistula in those children who were affected and therapeutical medical requirements, such as start of the oral route, intensive therapy and endotracheal intubation.

Table 2. Surgical events' characteristics of esophageal replacement with colon interposition in children

Characteristic	Value (n = 19)
Diagnosis	
– Caustic ingestion, n (%)	13 (68)
– Esophageal atresia III, n (%)	6 (32)
Cause of replacement	
– Caustic stricture, n (%)	13 (68)
– Dehiscence of plasty, n (%)	4 (21)
– Esophageal perforation, n (%)	1 (5)
– Long-gap, n (%)	1 (5)
Colon segment	
– Transverse, n (%)	8 (42)
– Transverse and descending, n (%)	7 (37)
– Ascending and transverse, n (%)	3 (16)
– Descending, n (%)	1 (5)

Discussion

Esophageal substitution with colon interposition using the retrosternal route is a very good esophageal replacement alternative in the pediatric age. The main indications for esophageal substitution are already described in the literature: long-gap esophageal atresia when primary anastomosis is not likely, esophageal

Table 3. Post-surgical complications in post-operative pediatric patients after esophageal replacement with colon interposition using the retrosternal route

Complications	Value (n = 19)
None, n (%)	12 (63%)
Cervical fistula, n (%)	3 (16)
Pneumonia, n (%)	3 (16)
Sepsis, n (%)	3 (16)
Atelectasis, n (%)	2 (10)
Occlusion by bridles, n (5)	2 (10)
Pneumothorax, n (%)	1 (5)
Meckel diverticulum, n (%)	1 (5)
Death, n (%)	1 (5)

Table 4. Management after esophageal replacement surgery with colonic interposition using the retrosternal route

Complications	Value (n = 19)
Days of surgical preparation, median (range)	5 (4-6)
Days, median (range)	4 (3-4)
Days to sepsis manifestation, median (range)	2 (2-3)
Days to control esophagram performance, median (range)	8 (6-15)
Days to fistula appearance, median (range)	10 (9-11)
Days to oral route start, median (range)	9 (7-16)
Days of intensive therapy, median (range)	6 (2-16)
Hospitalization days, median (range)	17 (14-28)
Days of intubation, median (range)	4 (1-11)

atresia with anastomotic dehiscence requiring esophagostomy, prematurity or respiratory distress precluding primary anastomosis, severe anastomotic stenosis unresponsive to dilatation, esophageal strictures due to caustic ingestion unresponsive to dilatation and gastroesophageal reflux stenosis[1,2]. This study captures the satisfactory experience in our institution with this procedure.

The main causes of substitution in the analyzed patients were the following: in the first place, esophageal stenosis due to caustic substances ingestion; in second place, dehiscence of the primary esophageal plasty, and, finally, there was a patient with type III esophageal atresia with esophageal anastomosis stenosis who presented an esophageal perforation caused by dilatations. With regard to the pull-up route for the chosen colonic segment, three routes have been recommended for graft mobilization: transthoracic, posterior mediastinal and retrosternal, each one with advantages and disadvantages. For example, in the posterior mediastinal pull-up route, the colonic passage is shorter and direct from the mouth to the stomach, avoiding kinks from neck to stomach; additionally, the literature refers that with this route, graft vascularization is not at risk of compression or kinking when brought into the chest, which is often seen with the subcutaneous or retrosternal approaches and that could be of concern due to an increase in the incidence of fistulae[3,5]. In our study, all esophageal replacements were performed using the retrosternal route, since in our institution we have more experience with this approach. This colonic mobilization route is technically simpler and the need for thorachotomy is avoided, the graft remains protected and, in addition, the risk for contamination of the thoracic cavity is eliminated in case of graft necrosis.

In our study, most patients undergoing esophageal substitution had a history of caustic substances ingestion and, for them, the recommeded route is retrosternal, since the thoracic approach is hindered by mediastinal fibrosis occurring in these patients[3,5].

Among the early complications, the main and most widely studied is cervical fistula of the coloesophageal anastomosis, the presentation of which varies according to different authors. For example, in 1998, Khan ER reported, in small series, 40% incidence of cervical fistula; Erdogan et al. reported a 72% incidence of anastomosis leak in small series of 15 patients; and in recent studies, Bothereau H reported 30% incidence of anastomosis leak. Notably, in our analysis, anastomotic cervical fistula only occurred in 3 patients, a lower number than those reported in world literature, even without the use of fibrin sealants, which reduce the risk of cervical fistula up to 28.5%[9,10].

With this study we corroborate that esophageal substitution with colon interposition using the retrosternal route is a safe end effective esophageal replacement technique in diseased children who are missing a mouth-to-stomach connection that allows the performance of their physiological needs, such as deglution for food intake. With this technique, the colon cannot substitute 100% of the native esophagus; the colon is used as a new conduit between the mouth and the stomach, thus offering the children the opportunity to eat in a more physiological manner; hence the importance and relevance of this surgical procedure.

Conclusions

The most common cause for substitution was stenosis due to caustic ingestion. The most widely used colon segment was transverse and antiperistaltic in all cases. The most common early complications observed in our study were cervical fistula, pneumonia and sepsis, which occurred with lower incidence than that reported in world literature.

Conclusions

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