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Operative Techniques

A simple technique of oblique anastomosis can prevent stricture formation in primary repair of esophageal atresia

Pieralba Catalano*, Maria Rita Di Pace, Anna Maria Caruso, Sergio Salerno, Marcello Cimador, Enrico De Grazia

Pediatric Surgical Unit, Department of Mother and Child Care, University of Palermo, Palermo, Italy

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Abstract

Background: Anastomotic stricture is an important problem after esophageal atresia (EA) repair. This study evaluates a technique of oblique esophageal anastomosis without use of a flap in order to prevent stricture formation.

Methods: Medical records of 16 patients (14 with EA type III and 2 with EA type IV Ladd-Gross classification) who underwent primary repair of EA at birth without anastomotic tension were reviewed, evaluating long-term follow-up results. All patients were studied with esophageal contrast study, pH-multichannel intraluminal impedance, and endoscopy. The incidence of complications and their management were analysed.

Results: Contrast esophagogram and esophagoscopy always showed regular patency of the suture line.

Conclusions: Our technique of oblique anastomosis is simple, safe, and effective in preventing stricture formation even in the long-term follow-up.

Anastomotic stricture is the main complication after surgical repair of esophageal atresia (EA), its incidence varying between 18% and 50% in different series [1-6].

Several predisposing factors have been implicated in the pathogenesis of stricture formation [5,8]; among them, the type of anastomosis performed seems to play a primary role.

Actually, transverse circular anastomosis is the commonest used technique. In this case, the suture line is in one plane, and it therefore has more chance of narrowing during healing, with subsequent circular fibrosis and stenosis in the anastomotic region [9].

Oblique anastomosis may be an alternative choice in order to avoid stricture formation; in fact this creates a wider anastomosis and unrestricted to one plane suture line.

In 1946 Gross first proposed this type of anastomosis for correction of EA, and recently, Yurcu et al demonstrated in an experimental study that the oblique suture line has more linear length than the transverse anastomosis [19,20].

To our knowledge, only a few cases of oblique anastomosis with use of an esophageal flap are reported in the literature in children treated for EA.

The aim of our study is to describe a type of oblique anastomosis technique performed without a flap and to

* Corresponding author. University of Palermo, Pediatric Surgical Unit, Department of Mother and Child Care, Palermo, Italy. Tel.: +0916555427; fax: +0916555469.

E-mail address: pieralba.catalano@libero.it (P. Catalano).

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assess its efficacy in preventing stricture formation after primary repair of EA, even in the long-term follow-up.

1. Materials and methods

A retrospective review on children with EA, operated on between January 2004 and December 2008 by the same surgeon, was carried out. Children with Ladd-Gross classification EA type I (pure esophageal atresia) and patients who suffered early mortality from comorbidities (major cardiovascular problems and severe prematurity) were excluded from the analysis. Sixteen patients (14 with Ladd-Gross classification EA type III and 2 with Ladd-Gross classification EA type IV), who underwent primary repair of EA at birth without anastomotic tension, were enrolled in the study.

The described technique was applied to all cases. The procedure was performed through a classic right extrapleural thoracotomy. The distal tracheoesophageal fistula was tied, and lower pouch was freed. After mobilization of the proximal end and closure of the fistula (if present), a traction suture was placed at the upper esophageal end and the upper pouch was opened with a "smile-shaped" transverse incision. This incision was performed with scissors, removing a very small, smile-shaped part of the esophageal wall muscular layer in order to reveal the mucosa, that was opened without tissue loss. A corresponding longitudinal incision was made on the anterior wall of the opened end of the lower esophagus, in order to spatulate it. This incision becomes right lateral when viewed in the supine position. The ends were then brought together, and all layers were sutured with interrupted 6.0 monofilament polyglycolic absorbable suture (Figs. 1-3).

The incidence of early and late complications (especially strictures) and their management were analysed.

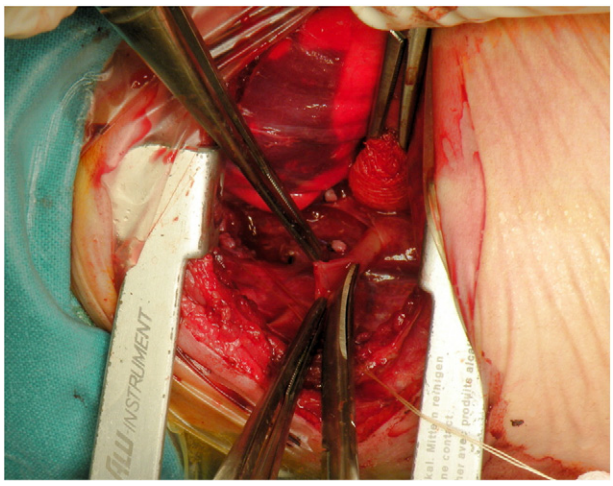

Fig. 1 A longitudinal incision, corresponding to the smile-shaped transverse incision of the upper pouch, is made on the anterior wall of the opened end of the lower pouch to spatulate it.

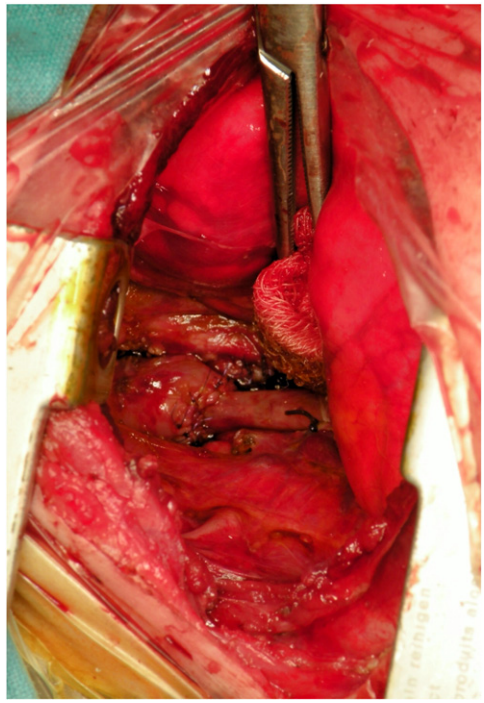

Fig. 2 The esophageal ends are brought together, and all layers are sutured with interrupted absorbable suture.

All patients underwent an esophageal contrast swallow on the 15th postoperative day to detect early complications, namely anastomotic leak, recurrent tracheoesophageal fistula and anastomotic stricture. pH-multichannel intraluminal impedance (pH-MII) was carried out at 6 months of age in order to screen gastroesophageal reflux (GER) and esophageal dysmotility, even in the absence of specific symptoms. Antacid therapy was started in the early postoperative period and continued as long as necessary. Esophagoscopy was performed at 1 and 3 years of age to evaluate for esophageal stricture and GER disease. Children were evaluated in follow-up examinations at regular intervals.

2. Results

Of the 16 children who underwent primary repair of EA, 10 were boys and 6 were girls. Eleven cases were diagnosed during the antenatal period owing to the presence of indirect signs of EA; the others were diagnosed at birth. The mean birth weight was 2350 ± 318 g. The minimum gestational age was 32.2 weeks. The distance between the ends of the pouches was 1 to 3 vertebral spaces.

Eleven patients were operated on the first day of life and the others within 48 hours. The mean operating time was 95 min (range 64–128 min). Patients were kept intubated and sedated for 5 days (range, 4-7) after the procedure. Oral feeding was started on postoperative day 7 in 15 patients and on postoperative day 8 in 1 patient. The mean hospital stay was 10 days (range, 8-12), and the minimum follow-up period was 3 years (range, 3-7 years).

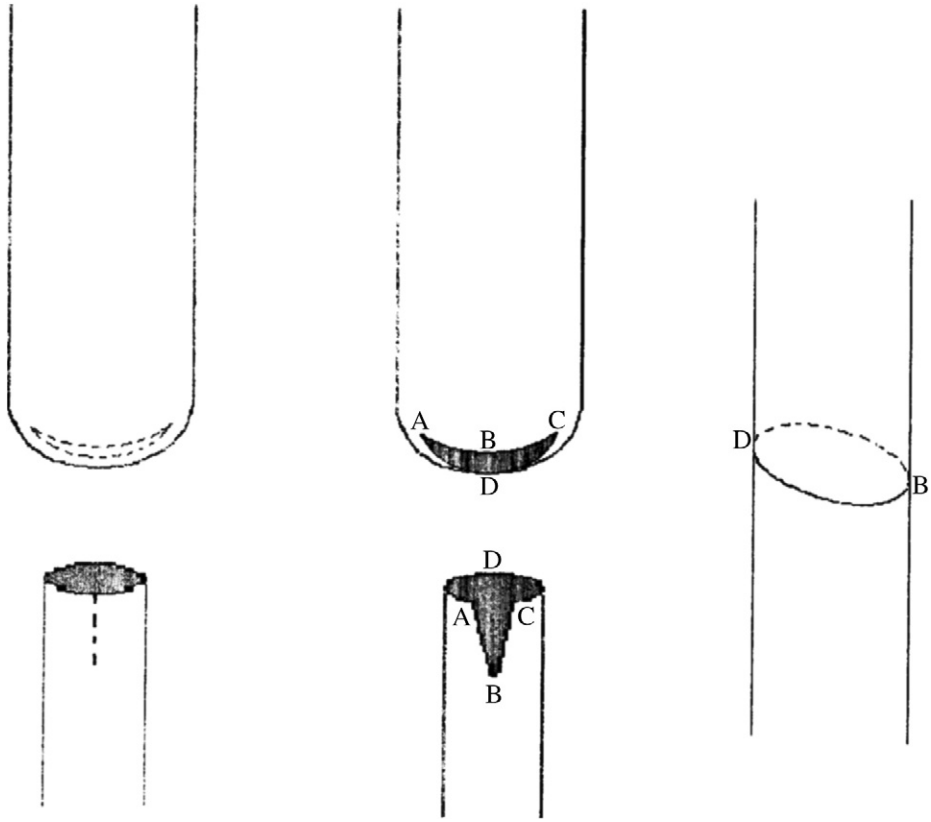

Fig. 3 The technique is characterized by a suture line unrestricted to one plane but performed without the use of a flap.

Esophageal contrast swallow performed at 15th postoperative day was negative for early complications such as anastomotic leak, recurrent tracheoesophageal fistula or anastomotic stricture in all patients. As for late complications, all children "presented GER and alterated bolus transit at pH-MII performed at 6 months of age and 2 children" with mild GER, reported dysphagia related to a more severe dysmotility. All patients were treated with antacid therapy until 1 year of age, when esophagogastroduodenoscopy was performed. In 6 patients endoscopy showed esophagitis; of these, 3 patients with severe GER required fundoplication at 2 years of age (2 cases with non-acid and 1 case with acid reflux); the other 3 patients with mild esophagitis were treated with medical therapy, but one case was unresponsive to antacid therapy and required fundoplication at 3 years of age. Among 10 patients without esophageal mucosal lesions at first endoscopy, 5 asymptomatic children showed mild esophagitis at 3 years of age and required only medical therapy.

Esophagoscopy always showed regular patency of the suture line.

3. Discussion

Anastomotic stricture still remains the most frequent complication after esophageal atresia repair [7,8]. Its incidence varies between 18% and 50%, depending upon the criteria for the definition of stricture [1-6]. Several predisposing factors can be implicated in the pathogenesis of the anastomotic stricture: nature of suture material [10], type of anastomosis [11-13], anastomotic tension related to gap length [14], tissue ischemia [10,15], anastomotic leak [10,15] and GER [16,17].

The anastomotic technique plays a very important role in the prevention of strictures [9,13,16].

End-to-end transverse circular anastomosis is the classically used method [13]. However, because anastomotic stricture is an important problem in EA repair, other techniques have been proposed to prevent it, obtaining a wide anastomosis without tension.

End-to-side anastomosis was described by Sulama et al to create a stabilized anastomosis with a large lumen and without traction on the distal esophagus [18]. The advantage of this technique was the very low stricture rate, but it has a potential risk of early and late recanalization of the ligated TE-fistula. However, end-to-side anastomosis shows the same undesirable feature as end-to-end anastomosis: the suture line is in a single plane, with increased probability of stricture formation during healing.

Oblique anastomosis was proposed as an alternative method to obtain a suture line in more than one plane, minimizing the risk of narrowing during healing [19].

Yurtcu et al compared the results of oblique and transverse anastomosis in an experimental study [20]. The diameter and the bursting pressure of the esophageal anastomotic

region in the oblique group was significantly higher than those in the transverse group ($P < .05$), confirming that oblique anastomosis is a better surgical procedure for preventing esophageal stricture.

Only a few cases of oblique anastomosis have been reported in children treated for EA.

Sharma described a technique in which a flap from the upper pouch is sutured to the antispatulated end of the lower pouch to achieve a tension free posterior suture line [16]. This creates a large anastomosis, but with tension on the anterior suture line.

In a subsequent technique proposed by Singh et al, a flap from the upper pouch is sutured to the spatulated end of the lower pouch to avoid tension on the suture line [21].

Another technique, recently reported by Melek et al [22], is based on bilateral longitudinal incisions on the distal end. The proximal end of the atretic esophagus is opened with a plus ("+")-shaped incision, creating 4 separate flaps, which are sutured to the edges of the distal end, obtaining a zigzag suture line in a curved fashion.

The aim of the last 2 techniques is to create a wide anastomosis, with a suture line unrestricted to one plane and with distribution of the tension along its entire circumference. Both these factors minimize the incidence of stricture formation. However, the disadvantage of the flap is tissue ischemia that may occur, causing anastomotic dehiscence.

Our technique has proven to be safe and effective, avoiding the onset of early postoperative complications (leak, recurrent fistula, and stricture) in all patients in our series, thus reducing the risk of subsequent morbidity and mortality.

The technique that we described is characterized by a suture line unrestricted to one plane but performed without the use of a flap. This provides the advantages of the oblique anastomosis, without the risk of tissue ischemia. The smile-shaped transverse incision on the blind upper pouch creates an edge of esophagus which corresponds to the spatulated lower pouch, allowing a perfect match of the esophageal ends. Furthermore, the procedure does not increase the distance between the 2 ends, since it is performed without tissue loss in the blind pouch.

Stricture formation did not occur in any patient at minimum follow-up period of 3 years (range, 3-7 years) and proves the efficacy of our technique. However, we cannot exclude that the use of prophylactic antacid therapy associated with close monitoring program, even in absence of symptoms, may minimize the effects of gastroesophageal reflux on the anastomotic suture line, contributing to prevention of strictures.

In our study, the incidence of GER and esophageal dysmotility is higher than in other reported series. This result may be explained by the use of pH-MII that is able to detect both acid and non acid reflux, the latter more frequent in infants especially those patients with EA [23]. Besides, pH-MII evaluates the bolus transit during 24 hours [24], demonstrating the presence of impaired esophageal motility.

We report a simple and safe technique of primary EA repair, effective in preventing stricture formation even in the long-term follow-up. It allows us to perform an esophageal anastomosis with a wider lumen diameter in which the tension of the entire circumference of the suture line is distributed in more than one plane. This technique is indicated for the surgical treatment of children with EA and tracheoesophageal fistula, when the distance between the esophageal ends is not very long and the anastomotic tension is not excessive.

Further multicentric prospective studies with an increased number of patients and a control group, treated with classical transverse anastomosis together with prophylactic treatment of GER, may be useful to evaluate the incidence of stricture formation after primary EA repair in absence of the GER effects.

References

[1] Michaud L, Guimber D, Sfeir R, et al. Anastomotic stricture following the surgical repair of esophageal atresia: frequency, risk factors, and the efficacy of esophageal dilatation. Arch Pediatr 2001;8:268-74.

[2] Engum SA, Grosfeld JL, West KW, et al. Analysis of morbidity and mortality in 227 cases of esophageal atresia and/or tracheoesophageal fistula over two decades. Arch Surg 1995;130:502-8.

[3] Nambirajan L, Rintala RJ, Losty PD, et al. The value of early postoperative oesophagography following repair of oesophageal atresia. Pediatr Surg Int 1998;13:76-8.

[4] Tsai JY, Berkery L, Wesson DE, et al. Esophageal atresia and tracheoesophageal fistula: surgical experience over two decades. Ann Thorac Surg 1997;64:778-83.

[5] Chittmittrapap S, Spitz L, Kiely EM, et al. Anastomotic stricture following repair of esophageal atresia. J Pediatr Surg 1990;25:508-11.

[6] Harmon CM, Coran AG. Congenital anomalies of the esophagus. In: Grosfeld JL, O'Neill JA, Fonkalsrud EW, Coran AG, editors. Pediatric surgery. Philadelphia: Elsevier; 2006. p. 1051-81.

[7] MacKinlay GA. Esophageal atresia surgery in 21st century. J Pediatr Surg 2009;18:20-2.

[8] Serhal L, Gottrand F, Sfeir R, et al. Anastomotic stricture after surgical repair of esophageal atresia: frequency, risk factors, and efficacy of esophageal bougie dilatations. J Pediatr Surg 2010;45:1459-62.

[9] Rickham PP. Oesophageal atresia. Triumph and tragedy. N J Surg 1977;47:138-43.

[10] Spitz L, Kiely EM, Brereton LJ. Oesophageal atresia: five years experience with 148 cases. J Pediatr Surg 1987;22:103-8.

[11] Hicks LM, Manfield PB. Esophageal atresia and tracheoesophageal fistula. Review of thirteen years' experience. J Thorac Cardiovasc Surg 1981;81:358-63.

[12] Holder TM, Cloud DT, Lewis Jr JE, et al. Esophageal atresia and tracheoesophageal fistula: a survey of its members by the Surgical Section of the American Academy of Pediatrics. Pediatrics 1964;34:542-9.

[13] Ein S, Ashcraft KW. In: Touloukian RJ. Discussion: long-term results following repair of esophageal atresia by end-to-side anastomosis and ligation of the tracheoesophageal fistula. J Pediatr Surg 1981;16:983-8.

[14] Jolly SG, Johnson DG, Roberts CC, et al. Patterns of gastroesophageal reflux in children following repair of esophageal atresia and tracheoesophageal fistula. J Pediatr Surg 1980;15:857-62.

[15] Gough MH. Oesophageal atresia—use of an anterior flap in the difficult anastomosis. J Pediatr Surg 1980;15:310-1.

[16] Sharma AK. Simple technique for proximal pouch mobilisation and circular myotomy in cases of oesophageal atresia and tracheo-esophageal fistula. J Pediatr Surg 1994;29:1402-3.
[17] Aprigliano F. Oesophageal stenosis in children. Ann Otol 1980;89: 391-5.
[18] Sulama M, Gripenberg I, Alvenainen EK. Prognosis and treatment of congenital atresia of the oesophagus. Acta Chir Scand 1951;102: 141-57.
[19] Gross RE, Scott Jr HW. Correction of esophageal atresia and tracheo-esophageal fistula by closure of fistula and oblique anastomosis of esophageal segments. Surg Gynecol Obstet 1946;82:518-27.
[20] Yurtcu M, Abasiyanik A, Arbag H, et al. An oblique anastomosis has more linear length than a transverse anastomosis of a tubular structure in oesophageal anastomosis. Pediatr Surg Int 2009;25:163-7.
[21] Singh SJ, Shun A. A new technique of anastomosis to avoid stricture formation in oesophageal atresia. Pediatr Surg Int 2001;17:575-7.
[22] Melek M, Cobanoglu U. A new technique in primary repair of congenital esophageal atresia preventing anastomotic stricture formation and describing the opening condition of blind pouch: plus ("+") incision. Gastroenterol Res Prac 2011:1-4.
[23] Catalano P, Di Pace MR, Caruso AM, et al. Gastroesophageal reflux in young children treated for esophageal atresia: evaluation with pH-multichannel intraluminal impedance. J Pediatr Gastroenterol Nutr 2011;52:686-90.
[24] Di Pace MR, Caruso AM, Catalano P, et al. Evaluation of esophageal motility and reflux in children treated for esophageal atresia with the use of combined multichannel intraluminal impedance and pH monitoring. J Pediatr Surg 2011;46:443-51.