Journal of Pediatric Surgery 50 (2015) 933–937

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Foker process for the correction of long gap esophageal atresia: Primary treatment versus secondary treatment after prior esophageal surgery

Sigrid Bairdain [a,1], Thomas E. Hamilton [a,1], Charles Jason Smithers [a], Michael Manfredi [b], Peter Ngo [b], Dorothy Gallagher [a], David Zurakowski [a,c], John E. Foker [d], Russell W. Jennings [a,*]

[a] Department of Pediatric Surgery, Boston Children's Hospital, Harvard Medical School, Boston, MA
[b] Division of Gastroenterology & Nutrition, Boston Children's Hospital, Harvard Medical School, Boston, MA
[c] Department of Anesthesiology, Perioperative & Pain Medicine, Boston Children's Hospital, Boston, MA
[d] University of Minnesota, Minneapolis, MA

ARTICLE INFO

Article history:
Received 25 February 2015
Accepted 10 March 2015

Key words:
Esophageal atresia
Foker process
Secondary long-gap esophageal atresia patients

ABSTRACT

Purpose: The Foker process (FP) uses tension-induced growth for primary esophageal reconstruction in patients with long gap esophageal atresia (LGEA). It has been less well described in LGEA patients who have undergone prior esophageal reconstruction attempts.
Methods: All cases of LGEA treated at our institution from January 2005 to April 2014 were retrospectively reviewed. Patients who initially had esophageal surgery elsewhere were considered secondary FP cases. Demographics, esophageal evaluations, and complications were collected. Median time to esophageal anastomosis and full oral nutrition was estimated using the Kaplan–Meier method. Multivariate Cox-proportional hazards regression identified potential risk factors.
Results: Fifty-two patients were identified, including 27 primary versus 25 secondary FP patients. Median time to anastomosis was 14 days for primary and 35 days for secondary cases ($p < 0.001$). Secondary cases ($p = 0.013$) and number of thoracotomies ($p < 0.001$) were identified as significant predictors for achieving anastomosis and the development of a leak. Predictors of progression to full oral feeding were primary FP cases (O.R. = 17.0, 95% CI: 2.8–102, $p < 0.001$) and patients with longer follow-up (O.R. = 1.06/month, 95% CI: 1.01–1.11, $p = 0.005$).
Conclusions: The FP has been successful in repairing infants with primary LGEA, but the secondary LGEA patients proved to be more challenging to achieve a primary esophageal anastomosis. Early referral to a multidisciplinary esophageal center and a flexible approach to establish continuity in secondary patients is recommended. Given their complexity, larger studies are needed to evaluate long-term outcomes and discern optimal strategies for reconstruction.

The difficulties in treating long gap esophageal atresia (LGEA) patients are well known, as are the controversies surrounding the operative repair. LGEA has not been defined precisely but includes any patient with esophageal atresia (EA) that cannot undergo an initial primary repair. Although, the definition of what constitutes LGEA has not been agreed upon, the overall goal is universal; to achieve a functional esophagus that allows for normal eating with lifelong durability. More recently in LGEA patients, axial tension on the proximal and distal esophageal segments has been shown to reliably induce sufficient esophageal growth to allow for a primary esophageal repair [1,2]. Initially described in 1997, the Foker process (FP) can be technically demanding; however, particularly when the atretic lower segments are very small [2].

One criticism of the FP is the relative rarity of LGEA cases overall, surgeon comfort-level and expertise, and, consequently, few centers have the patient volume required to construct, refine, and maintain the necessary skills in a multidisciplinary team dedicated to the treatment of these infants and young children [3]. Our own institution started utilizing the FP primarily for all LGEA patients in 2005; even less has been described in LGEA patients who have undergone prior reconstruction attempts and their outcomes versus primary repairs. Inherently, there is an added level of difficultly from prior reconstruction attempts, as well as unforeseen intricacies related to poor nutrition, access-related issues, and developmental concerns. Therefore, the purpose of this study is to 1) compare these two distinct cohorts to ascertain and evaluate potential differences in short-term outcomes, as well as complications; and, 2) suggest the best strategies for approach to both primary and secondary LGEA patients.

1. Methods

1.1. Basic demographics

Following institution review board approval (IRB Protocol M10-10-052), we retrospectively reviewed all cases of LGEA who were treated

* Corresponding author at: Department of Pediatric Surgery, Boston Children's Hospital, Director, Esophageal Atresia Program, 300 Longwood Avenue, Fegan 3, Boston MA, 02115. Tel.: +1 617 355 3038.
E-mail address: Russell.jennings@childrens.harvard.edu (R.W. Jennings).
[1] Co-First Authors.

http://dx.doi.org/10.1016/j.jpedsurg.2015.03.010
0022-3468/

from January 2005 to April 2014 at Boston Children's Hospital (BCH). Primary LGEA patients were those patients who did not undergo a previous operation or whose previous operations were limited to a gastrostomy placement. Those patients who had esophageal surgery elsewhere were considered secondary FP cases. Previous operations included thoracotomies with repair of proximal and distal tracheoesophageal fistulas (TEF), primary repair of esophageal atresia, attempted repair of esophageal atresia by Foker process (FP) and esophageal replacements. Previous operations also included those related to secondary complications including mediastinitis, chylothoraces, empyemas, recalcitrant strictures, and dilation-related perforations.

Patient-data collected included: basic demographics, associated anomalies, gap length, time to complete Foker process (FP), intensive care (ICU) data, number of thoracotomies, stricture treatment and dilations, complications, length of follow-up and patient outcome. Patient outcomes were further subdivided into the following: attainment of a functional native esophagus, or whether an interposition was required; and, eating by mouth solely versus supplementation and/or primarily enteral feeds. Complications recorded included symptomatic venous thromboembolic events (VTE) and fractures. Routine screening was not performed for these events. Mortality was also recorded.

1.2. Operative technique

The Foker process was conducted by the surgeons on the esophageal atresia multidisciplinary team on both primary and secondary cases through a 3–4 centimeter posterior thoracotomy incision [2]. Both upper and lower esophageal segments were identified and mobilized within the right pleural space. The 3rd and 7th intercostal spaces were opened utilizing the same skin incision in the cases of longer gaps. Pledgeted traction sutures of 5-0 or 6-0 Prolene® were placed in the upper and lower esophageal segments for external traction. Sutures were placed through the muscular and submucosal layers. The esophageal segments were enclosed in silastic sheeting. Tension was increased daily at the bedside by placing segments of feeding tubes under the sutures. Movement of clips placed on the esophageal segments was monitored by serial radiographs. Weekly contrast studies were performed to confirm that the lumen was lengthening along with the esophageal wall and to identify potential esophageal leaks. Repeat thoracotomies were done when replacement and reconfiguration of the sutures were needed to reestablish tension, as well as when an esophageal anastomosis or interposition was performed.

1.3. Statistical analysis

Univariate analysis was used to compare demographic and clinical data as well as patient outcomes including achievement of esophageal anastomosis, venous thrombotic events (VTE), fractures, full oral nutrition, reoperation rates, and mortality. Birth weight, gap length, intensive care (ICU) and hospital stay, ventilation days, number of dilations and thoracotomies were compared between primary and secondary FP cases using the Mann–Whitney *U*-test with data summarized using the median and range. Simple proportions were compared by Fisher's exact test for binomial data. Kaplan–Meier time-to-event analysis was performed to compare time to achievement of esophageal anastomosis and freedom from fractures between primary and secondary FP cases with the log-rank test to compare the curves and Greenwood's formula to calculate 95% confidence intervals [4].

Multivariable logistic regression was applied to identify independent predictors of esophageal anastomosis and leaks in order to control for possible confounding with odds ratios (OR) and 95% CIs for significant predictors [5]. Statistical analysis was conducted using IBM SPSS Statistics (version 21.0, IBM, Armonk, NY). Two-tailed values of $p < 0.05$ were considered statistically significant. Power analysis indicated that a minimum of 25 primary and 25 secondary FP cases would provide 80% power to detect 30–40% differences with respect to patient outcomes including anastomosis, leaks, VTEs and fractures using Fisher's exact test (version 7.0, nQuery Advisor, Statistical Solutions, Saugus, MA).

2. Results

Fifty-two patients were analyzed during this study period. Twenty-seven were classified as primary FP patients and twenty-five were classified as secondary FP patients. These latter patients presented from 5 US states and 3 other countries. Reported birth weight (BW), estimated gestational age (EGA), and estimated gap length were similar between the two cohorts at baseline. There were also no significant differences in gender, cardiac defects, and baseline VACTERL phenotypes. Weight for age Z scores, a marker for nutritional status, was not significantly different at hospital admission; median Z-scores of −1.26 for primary FP patients versus −1.18 for secondary FP patients respectively. The median weight at the FP was 5 kg (4.1–7.9 kg). There was not a significant difference between the two cohorts. The median age at time of Foker process was 4 months (range: 2–7 months) (Table 1)

Eighteen (67%) of the primary FP presented as “pure”, or isolated LGEA patients. The remaining 9 (33%) patients had a proximal fistula. Of the 25 secondary FP patients, 13 had a failed FP process, 10 patients had a failed type C-EA primary repair and 2 had a failed colonic interpositions. Three primary FP patients had Trisomy-21 (Down's syndrome) versus 4 patients within the secondary FP cohort. Within the secondary FP patients, 8 had a cervical esophagostomy (5 right-sided and 3 left-sided esophagostomies). Three patients presented with a tracheostomy and 24% (n = 6) of the secondary FP patients had either single or bilateral vocal cord paresis/paralysis. Median attempts at FP repair prior to hospitalization at our institution were 2 (range: 1–4 attempts) and the complications included 1 esophageal stent erosion and 2 empyemas.

Median time (days) to initiating the FP after admission was different between cohorts; repair of the primary patients was begun after 24 days (range: 1–144 days) and by 8 days (range: 1–361 days) for secondary patients. The number of thoracotomies differed at baseline between the two groups ($p < 0.001$) with the secondary FP cases requiring more thoracotomies during their hospital stay. Median time from

Table 1

Characteristics of primary and secondary LGEA patients

Characteristic	Primary FP cases (n = 27)	Secondary FP cases (n = 25)	P value
Birth weight, kg	2.3 (0.8–4.6)	2.9 (1.5–3.7)	0.7
Gestational age, weeks	37 (25–39)	36 (29–39)	0.4
Estimated gap length, cm	4.5 (2.9–6.0)	5.0 (1.6–9.0)	0.2
Male gender	17 (63%)	12 (48%)	0.4
Cardiac defects	11 (41%)	9 (36%)	0.7
VACTERL	10 (37%)	9 (36%)	1.0
Hospital stay, days	108 (22–269)	134 (64–685)	0.03*
ICU stay, days	70 (22–217)	110 (35–685)	0.04*
Paralytics, days	17 (0–64)	44 (0–133)	<0.001*
Mechanical ventilation, days	24 (15–173)	46 (9–236)	0.005*
VTE	3 (11%)	12 (48%)	0.005*
Fractures	5 (19%)	15 (60%)	0.004*
# of thoracotomies	2 (2–10)	5 (2–15)	<0.001*
# of dilations in hospital**	3 (0–18)	5 (0–20)	0.6
Intact esophagus	26 (96%)	17 (68%)	0.01*
Full oral nutrition	17 (63%)	2 (9%)	<0.001*
Mortality	0 (0%)	2 (8%)†	0.2

Continuous data are expressed as median (range). ICU = intensive care unit; LGEA = long gap esophageal atresia, VTE = venous thromboembolism.

* Statistically significant.

** Number of dilations during the primary hospital stay for original Foker process.

† No patients died in hospital, however two patients with complex anatomy with failed attempts at repair died after discharge (one had multiple additional complex medical problems).

beginning the FP to anastomosis was 14 days (interquartile range: 11–17 days) for primary and 35 days (interquartile range: 24–40 days) for secondary cases ($p < 0.001$) (Fig. 1). Twenty-six percent ($n = 7$) of the primary FP and 68% ($n = 17$) of the secondary FP patients developed a leak while in undergoing the FP. Having had prior attempts at repair (secondary FP patients) ($p = 0.013$) and the number of thoracotomies required ($p < 0.001$) were identified as significant predictors for not achieving an anastomosis and the development of a leak (Table 2). EGA ($p = 0.82$), gap length ($p = 0.37$), and total ventilator days ($p = 0.21$) were not independent predictors for achieving an anastomosis or the development of a leak. Of the secondary FP patients, 25% (1 out of 4) of those patients with Trisomy-21 ultimately had an esophageal anastomosis versus 100% of the primary FP cases with Trisomy-21.

Intensive care (ICU) characteristics during the FP were also recorded. Hospital length of stay ($p < 0.03$) and intensive care length of stay ($p < 0.04$) were significantly longer in the secondary FP patients (Table 1). Secondary FP patients' median hospital stay was 134 days of which 110 days were within the ICU. Secondary FP patients required significantly longer cumulative days of paralysis ($p < 0.001$) and mechanical ventilation ($p < 0.001$) (Table 1). Thirty-eight percent ($n = 20$) of all LGEA patients developed a fracture, whereas 29% ($n = 15$) of all LGEA developed a symptomatic VTE during the study time period. All VTE were line-related and confirmed by imaging; fractures were also symptomatic and confirmed on imaging. Of the fractures, 8 patients were diagnosed with a fracture of the humerus, 6 were diagnosed with a fracture of the femur, and 6 were diagnosed with both. Secondary FP cases were more likely to have been diagnosed with a fracture ($p = 0.004$) and symptomatic venous thromboembolic events ($p = 0.005$) during their primary hospital stay (Table 1). The estimated percentage of patients free from fractures at 90 days was 80% (95% CI: 67–93%) for primary cases and 50% (95% CI: 35–65%) for secondary cases, indicating a much higher fracture risk for secondary cases (Fig. 2).

Dilations during primary hospital stay did not differ significantly between these two groups ($p = 0.6$). Sixty-three percent ($n = 17$ patients) of the primary FP cases had undergone a fundoplication for persistent reflux whereas 60% ($n = 15$ patients) of the secondary FP patients had undergone a fundoplication. Seven patients progressed to requiring operative resection of their strictures. The overall incidence was 13.5% ($n = 7/52$) for the entire cohort. Four of the patients were secondary FP patients and 3 patients were primary FP patients. The median number of days to stricture resection was 190 days (range: 123–363 days).

Table 2
Case complexity (Primary vs. Secondary case) and number of thoracotomies correlates with successful anastomosis and leak rates.

	Entire cohort	Primary cases	Secondary cases
Surgical anastomosis depends on case complexity and Number of thoracotomies			
Overall	43/52 = 83%	26/27 = 96%	17/25 = 68%
Number of thoracotomies			
2–5	39/39 = 100%	26/26 = 100%	13/13 = 100%
>5	4/13 = 31%	0/1 = 0%	4/12 = 33%
Development of leaks depends on case complexity and Number of thoracotomies			
Overall	24/52 = 46%	7/27 = 26%	17/25 = 68%
Number of thoracotomies			
2–5	12/39 = 31%	6/26 = 23%	6/13 = 46%
>5	12/13 = 92%	1/1 = 100%	11/12 = 92%

Multivariable logistic regression analysis indicated that LGEA case complexity (primary versus secondary FP cases) and number of thoracotomies were the strongest predictors of surgical anastomosis and occurrence of leaks. Primary FP and secondary FP cases with >5 thoracotomies were unlikely to achieve connection and very likely to have leaks, as depicted in the stratification above. On the other hand, 96% primary cases achieved a connection. Although leaks occurred in the overall cohort, they were much less common in primary than secondary cases (overall 26% vs. 68%; 2–5 thoracotomies: 23% vs. 46%).

The overall median follow-up for the entire cohort was 16 months (range: 8–35 months). For the 27 primary patients, the median follow-up was 16 months (range: 4–46 months). For the 25 secondary Foker process patients, the median follow-up was 16 months (9–24 months). Sixty-three percent ($n = 17$ patients) of the primary FP cases had reached full oral nutrition versus 9% ($n = 2$ patients) of the secondary FP cases at last-follow-up. Multivariate independent predictors of progression to full oral feeding were primary FP cases (OR = 17.0, 95% CI: 2.8–102, $p < 0.001$); and, patients with longer follow-up (OR = 1.06/month, 95% CI: 1.01–1.11, $p = 0.005$). None of those patients who presented initially with a cervical esophagostomy attained full oral nutrition in the time of follow-up. One primary patient did not achieve a native esophagus, secondary to a dilation-related perforation; currently, she has an esophagostomy and gastrostomy tube. Of the secondary patients who did not achieve a native esophagus, 4 have subsequently undergone interposition utilizing the jejunum. None of the primary FP cases died during their hospital course or following discharge. Of the secondary FP cases, no patients died in hospital; however, two patients with complex anatomy, and with failed attempts at in-hospital repair, died following discharge.

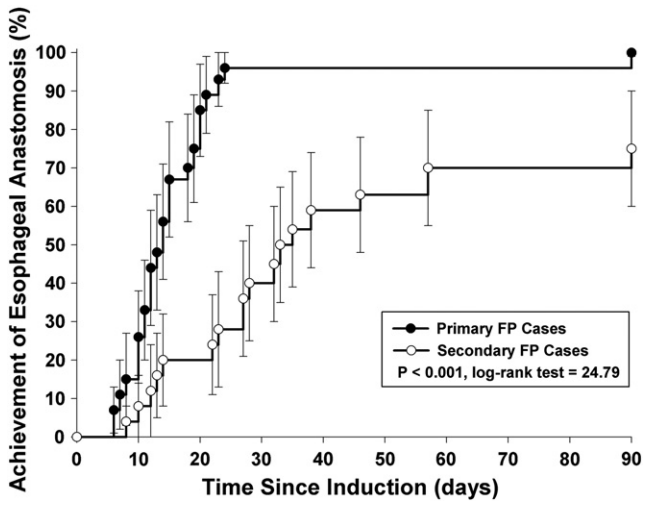

Fig. 1. Kaplan–Meier curves illustrating time to achievement of esophageal anastomosis for primary and secondary FP cases ($p < 0.001$, log-rank test = 24.79). Median time to anastomosis was 14 days for primary FP cases and 35 days for secondary FP cases. The estimated percentage of patients attaining anastomosis at 30 days is 96% (95% CI: 92–100%) for primary cases and 40% (95% CI: 25–55%) for secondary cases, confirming a higher rate of anastomosis for primary cases. Error bars denote 95% confidence intervals as determined by Greenwood's formula.

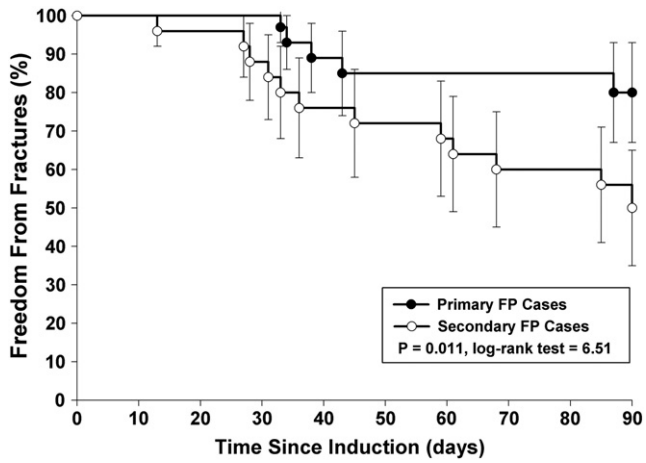

Fig. 2. Kaplan–Meier curves illustrating freedom from developing fractures for primary and secondary FP cases ($p = 0.011$, log-rank test = 6.51). The estimated percentage of patients free from fractures at 90 days is 80% (95% CI: 67–93%) for primary cases and 50% (95% CI: 35–65%) for secondary cases, indicating a much higher fracture risk for secondary cases. Error bars denote 95% confidence intervals as determined by Greenwood's formula.

3. Discussion

During this nine-year time-period, we have seen a heightened complexity in the cohorts of LGEA patients born, referred, transferred, and treated at our institution. The overall incidence of esophageal atresia, a rare congenital anomaly, occurs in 1:4500 live births [6]. The exact incidence of LGEA is not known; however, several studies have employed the FP for LGEA but many of these studies have been on a smaller scale and even fewer have included revision cases [7–9]. This may be one of the largest reports of secondary LGEA cases treated at a single institution; however, despite being successful in repairing infants with primary LGEA, our success rate with achieving a native esophageal conduit in secondary LGEA/FP patients has not been as high (96% versus 68%). Furthermore, attaining full oral nutrition in this particular cohort of secondary FP patients has been complicated by oral aversion, aspiration, and continued reflux; this has been associated with longer hospital stays, increased number of thoracotomies, and/or leak repairs.

Similar to other neonatal and pediatric conditions, advances in medical and intensive care management for neonates with esophageal atresia have improved overall survival rate; perioperative and postoperative morbidity now remain the significant prognosticators of a "successful outcome" [10]. Unlike previous reports, neither birth weight nor cardiac defects played a significant role in our overall mortality and morbidity [11]. Other congenital anomalies, birth weight, gender, as well as several ICU factors did not portend an increased risk for mortality and/or morbidity in our cohorts. The added morbidity and, in part the complexity that comprises LGEA as a whole, is the lack of a universal definition, along with inherent complexity and diversity within the superimposed categories of primary and secondary FP patients. For example, our secondary FP patients' anatomy included failed Foker attempts, previous type C esophageal atresia repairs, and previous colonic conduits.

These artificial categories of primary versus secondary FP cases also do not address their associated airway anomalies, cardiac repairs, nor the intricacies utilized for surgical repair. While we agree that there are challenges in using the Foker process to treat LGEA as whole; we may have underestimated the added complexity and synergy of these previous operations. Some of the previous procedures included the creation of an esophogastomy thus, potentially creating increased risk for vocal cord paresis and inability to eat by mouth secondary to aspiration concerns. Previously attempted conduit creation and cervical esophagostomy may require neck dissection, thoracotomy or mediastinal dissection, and a major laparotomy for conduit mobilization. This is turn negates any potential for virginal surgical planes. Considering the time, multiple operations, and additional risks of a complex laparotomies and thoracotomies, earlier approach to solving the LGEA problem in secondary FP cases is warranted with referral to a multidisciplinary center.

Our results are not surprising as it relates to the synergy between cohort category, increased number of thoracotomies, increased potential for leaks, and its inverse relationship with the likelihood of achieving an esophageal anastomosis. Unfortunately, leaks are common in the management of children with LGEA as a whole; leak rates of 30% or higher are consistently reported in the literature [12–15]. This, in turn, may be related to an increased need for dilations secondary to stricture formation at previous leak site. Similar to contemporary studies, while it is not uncommon for LGEA patients to require dilations postoperatively [15], the underlying outcomes may be vastly different between primary and secondary FP patients; secondary FP case may continue to have an associated recalcitrant stricture and potential weak-point in the native esophagus [16].

During the Foker process, necessary adjunct therapies include mechanical ventilation, extended pharmacological paralysis, sedation and analgesia, and utilization of CVCs to facilitate medication and parenteral nutrition (PN) administration [17]. We saw an increased rate of fractures and VTEs in our secondary FP patients; however, these were identified and addressed with treatment algorithms, and reduction in days of paralysis, as well as loop diuretics. Mid-term outcomes have also shown a statistical difference in those who are eating fully by mouth; approximately 63% of the primary FP cases versus 9% of the secondary FP cases. This is predicated though on several assumptions including: 1) more recent cases may need longer time for follow-up; and 2) the likelihood of achieving full oral nutrition increases per month of follow-up. Despite this, the combination of repeat thoracotomies, leaks and formation of strictures, longer mechanical ventilation may potentiate failure to progress to full oral nutrition and sustained oral aversion. Longer-term follow-up is needed to address this issue.

There are a number of limitations that need to be addressed for this study. First, this is a retrospective design, although our cohort is one of the largest in the literature. Second, both of our cohorts included complex patients who required many distinct adjunct medical therapies, which may have contributed to outcomes and confounded the influence of our surgical treatment plans alone. Finally, follow-up intervals were variable for both cohorts, and relatively short-term for the more recent primary FP. We will continue to follow these patients long-term to assess any additional benefits or pitfalls of the multidisciplinary approach.

4. Future directions and conclusion

The FP has been successful in repairing infants with primary LGEA. Secondary LGEA patients are more challenging to achieve esophageal anastomosis with this technique. Early referral to a multidisciplinary esophageal center and a flexible approach to establish continuity in secondary patients is recommended. Given their complexity, larger studies are needed to evaluate long-term outcomes and discern optimal strategies for reconstruction.

Appendix A. Discussion

Presenter: Sigrid Bairdain, MD, Boston, MA

Discussant: DR. ARNOLD CORAN, Ann Arbor, MI: Thank you for that very nice presentation. One of the factors you need in evaluating results with long gap esophageal atresia is the length of the gap. Did you measure that gap? And what technique did you used to measure it, and when did you measure it in the course of the patient's treatment?

Response: DR. BAIRDAIN: I apologize that I did not list on our data slides the factors that were not significant for predicting outcome, which is similar to studies that have just been published in *JPS*. So gap length, VACTERL status, cardiac status were not significant predictors for anastomosis, as well as predicting for oral feeding.

As far as the second question, we did preoperative fluoroscopy studies prior to their actual first trip to the operating room, and then we also evaluated the gap intraoperatively as well, so at two time points. But again, those measurements in our cohort had no implication on the overall outcome.

Discussant: MALE VOICE (from audience) Thank you for sharing this experience. It's obviously a huge experience with this strategy. It strikes me that these two groups of patients, though, are quite different. At your institution, are all the long gap esophagus atresia patients collected in this series to where they all get a Foker strategy or in your institution were there some that had a gastrostomy and delayed procedure experience? And could you compare those groups?

Response: DR. BAIRDAIN: Since 2005, the institutional trend has been to use the Foker process in total, so all long gap patients are treated with the Foker process at Boston Children's. I will say it's a little bit of a misnomer to make this artificial distinction between primary and secondary. Each of these patients as an individual are very difficult to manage, so I think it's a little bit difficult just in a binary way to distinguish between these two groups and how difficult they are. But no, we don't usually use any other forms of reconstruction.

References

[1] Hendren WH, Hale JR. Electromagnetic bougienage to lengthen esophageal segments in congenital esophageal atresia. NEJM 1975;293:478–82.
[2] Foker JE, Linden BC, Boyle EM, et al. Development of a true primary repair for the full spectrum of esophageal atresia. Ann Surg 1997;226:533–43.
[3] Ron O, De Coppi P, Pierro A. The approach to esophageal atresia repair and the management of long-gap atresia: results of a survey. Sem Pediatr Surg 2009;18:44–9.
[4] Hosmer DW, Lemeshow S. Applied survival analysis. Regression modeling of time to event data. New York: John Wiley & Sons; 1999 27–86.
[5] Harrell FE. Regression modeling strategies. With applications to linear models, logistic regression, and survival analysis. New York: Springer; 2001 215–67.
[6] David TJ, O'Callaghan SE. Oesophageal atresia in the South West of England. J Med Genet 1975;12(1):1–11.
[7] Sroka M, Wachowiak R, Losin M, et al. The Foker technique (FT) and Kimura advancement (KA) for the treatment of children with long-gap esophageal atresia (LGEA): lessons learned at two European centers. Eur J Pediatr Surg 2013 Feb; 23(1):3–7. http://dx.doi.org/10.1055/s-0033-1333891 [Epub 2013 Feb 1].
[8] Till H, Muensterer OJ, Rolle U, et al. Staged esophageal lengthening with internal and subsequent external traction sutures leads to primary repair of an ultra-long gap esophageal atresia with upper pouch tracheoesophagel fistula. J Pediatr Surg 2008; 43(6):E33–5. http://dx.doi.org/10.1016/j.jpedsurg.2008.02.009.
[9] Ortiz R, Galán AS, Martinez L, et al. Tertiary surgery for complicated repair of esophageal atresia. Eur J Pediatr Surg 2015;25(1):20–6.
[10] Alshehri A, Lo A, Baird R. An analysis of early non-mortality outcome prediction in esophageal atresia. J Pediatr Surg 2012;47(5):881–4.
[11] Spitz L. Oesophageal atresia. Orphanet Journal of Rare Diseases 2007;11(2):24.
[12] Friedmacher F, Puri P. Delayed primary anastomosis for management of long-gap esophageal atresia: a meta-analysis of complications and long-term outcome. Pediatr Surg Int 2012;28(9):899–906.
[13] Chittmittrapap S, Spitz L, Kiely EM, et al. Anastomotic leakage following surgery for esophageal atresia. J Pediatr Surg 1992;27(1):29–32.
[14] Sri Paran T, Decaluwe D, Corbally M, et al. Long-term results of delayed primary anastomosis for pure esophageal atresia: a 27-year follow-up. Pediatr Surg Int 2007;23(7):647–51.
[15] Séguier-Lipszyc E, Bonnard A, Aizenfisz S, et al. The management of long gap esophageal atresia. J Pediatr Surg 2005;40(10):1542–6.
[16] Spitz L, Kiely EM, Drake DP, et al. Long-gap esophageal atresia. Pediatr Surg Int 1996; 11:462–5.
[17] Bairdain S, Kelly DP, Tan C, et al. High incidence of catheter-associated venous thromboembolic events in patients with long gap esophageal atresia treated with the Foker process. J Pediatr Surg 2014;49(2):370–3.