The American Journal of Surgery 213 (2017) 640–644

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Routine post-operative esophagram Is not necessary after repair of esophageal atresia

Jamie Golden, Natalie E. Demeter, Joanna C. Lim, Henri R. Ford, Jeffrey S. Upperman, Christopher P. Gayer*

Children's Hospital Los Angeles, Division of Pediatric Surgery, 4650 Sunset Blvd, Los Angeles, CA 90027, USA

ARTICLE INFO

Article history:
Received 1 July 2016
Received in revised form
24 October 2016
Accepted 29 December 2016
Abstract presented at the Society of Black Academic Surgeons Annual Meeting April 30, 2016 in Columbus, Ohio.

Keywords:
Esophagram
Tracheoesophageal fistula
Esophageal atresia
Anastomotic leak

ABSTRACT

Introduction: Esophagrams are routinely performed following repair of esophageal atresia (EA) with or without tracheoesophageal fistula (TEF); however, its utility has not been validated.
Methods: EA/TEF repair performed from 2003 to 2014 at a single pediatric hospital and from 2004 to 2014 in the Pediatric Health Information System (PHIS) database were retrospectively reviewed to determine utility of esophagrams.
Results: Esophagram was performed in 99% of patients at our institution (N = 105). Clinical signs were seen prior to esophagram in patients whose leak changed clinical management. Esophagram on post-operative day ≤15 was performed in 66% of PHIS database patients (N = 3255). Esophagram did not change the incidence of chest tube placement, reoperation, or dilation. Patients who required a reoperation were less likely to have an esophagram than patients who did not require a reoperation (40.7% versus 65.7%, $p < 0.001$).
Conclusion: Our data suggest that routine esophagram is not necessary in asymptomatic patients.

Summary statement

Routine post-operative esophagram is not necessary in the evaluation of asymptomatic patients to detect a leak or a stricture. Here, we evaluate our institutional data and a national database to show that routine use of esophagram does not affect patient outcomes and that clinically relevant leaks present with symptoms prior to esophagram.

1. Introduction

Esophageal atresia (EA) with or without tracheoesophageal fistula (TEF) is a congenital anomaly that occurs in 1 in every 2500–3000 live births.[1] Repair involves ligation of the fistula and primary anastomosis of the esophagus. Survival approaches 100% in the absence of other malformations.[2] EA/TEF repair is an index pediatric surgical procedure, yet the operative approach and post-operative management of these infants is variable.[3,4]

Post-operative esophagram is commonly used to evaluate the anastomosis for leaks or strictures prior to the initiation of oral feeds. An anastomotic leak is an early complication that occurs in up to 20% of patients and may require an esophageal stent, chest tube drainage, or reoperation.[1,5–7] Esophageal stricture is a late complication that occurs in 15–55% of patients and is typically managed with endoscopic dilation.[1,5,8] According to recent surveys of pediatric surgeons, 72–85% routinely perform an esophagram, most commonly around post-operative day seven.[3,4]

Despite its widespread use, the routine use of a post-operative esophagram has not been validated and may be unnecessary. These imaging studies rarely identify a leak, increase cost, and increase infant radiation exposure. Previous studies report the incidence of an asymptomatic leak on esophagram as 0.8–10%. These radiologic leaks alone did not result in a change in patient management.[5,6,9] Further, an esophagram has an effective radiation dose of 1.5–4 millisieverts, which is equivalent to 75–200 chest X-rays.[10] We hypothesized that routine post-operative esophagram is not necessary in the evaluation of a leak or stricture in asymptomatic patients following EA repair. Further, we propose that leaks requiring a change in patient management can be detected without

* Corresponding author. Division of Pediatric Surgery, 4650 Sunset Blvd., Mail-stop #100, Los Angeles, CA 90027, USA.
E-mail addresses: Jgolden@chla.usc.edu (J. Golden), nedemeter@gmail.com (N.E. Demeter), Joanna.c.lim@gmail.com (J. C. Lim), Hford@chla.usc.edu (H.R. Ford), Jupperman@chla.usc.edu (J.S. Upperman), Cgayer@chla.usc.edu (C.P. Gayer).

http://dx.doi.org/10.1016/j.amjsurg.2016.12.020
0002-9610/

the use of esophagram and that esophagram does not change management or outcome after EA repair. Here, we evaluate outcomes of EA/TEF repair performed at a single pediatric hospital and in a national multicenter database.

2. Methods

2.1. Single center review

Following IRB approval, medical records of all infants who underwent an EA repair from 2003 to 2014 at a single pediatric hospital were retrospectively reviewed. All patients were admitted prior to 30 days of life, had an EA repair during their admission, and were discharged from the hospital prior to data extraction. Patients were excluded if they had a type E fistula without an esophageal atresia, if they were transferred to another hospital prior to esophagram, or if they had a cervical esophagostomy as their initial operation. Data collected include demographics, operative records, and esophagram findings. Outcomes included reoperation, stent, chest tube placement, esophageal dilation, and death.

2.2. Pediatric Health Information System

A national overview of the use of esophagrams in EA/TEF patients was evaluated using the Pediatric Health Information System (PHIS) database. PHIS is an administrative database from 48 children's hospitals in the United States including 26 states and 48 cities that contains clinical and resource utilization data.[11] With the help of a PHIS data analyst, the database was queried to identify all inpatient EA/TEF patients from 2004 to 2014 using the ICD-9 codes for tracheoesophageal fistula and esophageal atresia (750.3 and 530.84). All patients included in our study had an admission age $\leq$30 days, had a TEF/EA repair during their admission, and had been discharged from the hospital prior to the data extraction. Patients were excluded if a cervical esophagostomy was performed as the initial operation. Type of fistula was not available in the PHIS database so all TEFs were included (Type A, B, C, D, H). Only a patient's first admission to the hospital was included in our analyses to ensure there was no duplicate data. Outcomes include reoperation, esophageal dilation, pneumothorax, pleural effusion, length of stay (LOS), and death. All outcomes were defined using ICD-9 diagnosis and procedures codes.

2.3. Statistics

Descriptive statistics, percentages, and counts for all demographic variables were calculated. Student's t-test, Kruskal-Wallis test, and chi-square tests were used. Data are represented as mean ± standard error of the mean (SEM) unless otherwise specified. All analyses were completed using GraphPad Prism 6.0. A result of $p < 0.05$ was considered significant.

3. Results

3.1. Single center review

A single center retrospective review was performed to evaluate our institutional utilization of esophagrams after EA repair and patient outcomes. Six patients were excluded for type E fistula without an esophageal atresia (N = 5) and for transfer to another hospital prior to esophagram (N = 1). No patient had a cervical esophagostomy as their initial operation. Patients were predominantly male (52.4%) and Hispanic (56%). Infants included had an average birthweight of 2494 ± 75.5 g and an average gestational age of 36.5 ± 0.4 weeks. Mean age at EA repair was 13.3 ± 3.5 days (range 1–180). The majority of TEF/EA were type C (98%) and the remaining were type A (2%). Nine patients (8.6%) had a long gap atresia (Table 1).

Post-operative chest x-ray revealed a pneumothorax in 45 (42.9%), pleural effusion in 44 (41.9%), and pneumonia in 8 (7.6%). A chest tube was placed post-operatively for pneumothorax or effusion in 14 (13.3%).

An esophagram was performed in 104 out of 105 (99%) patients on post-operative day (POD) 7.9 ± 0.5. The one patient who did not have an esophagram went home with hospice care due to comorbidities diagnosed after repair. Eight (7%) patients had a leak on esophagram. Four of these patients had no clinical signs of a leak, and all resolved without any intervention. The remaining four patients had clinical signs of a leak (respiratory distress, pleural effusion, pneumothorax) prior to esophagram. One required a stent, one required a thoracotomy, and two required placement of a chest tube.

Of the 96 patients without a leak on esophagram, 35 (33%) had a normal esophagram and 62 (60%) had esophageal narrowing. Esophageal dilation of a stricture was required in 37% of patients who initially had a normal esophagram and in 27% of patients who had a narrowing seen on the initial esophagram.

There were three mortalities in patients who had an esophagram. One patient died of pulmonary hypertension and sepsis and two had trisomy 18, a universally lethal genetic disorder. All three had a normal post-operative esophagram. One patient who did not have an esophagram died at home hospice.

3.2. PHIS database

The PHIS database was evaluated to determine the applicability of our single center results in a multicenter population. A TEF/EA repair was performed in 3255 patients during our study period. The mean age at EA repair was 11.9 ± 32 days (range 0–562 days) old. We evaluated all esophagrams performed within the first month post-operatively and included those within two standard deviations of the mean in our analysis (POD 0 − POD 15). Thus, no esophagrams done after POD 15 were included. Esophagrams were performed on POD 7.1 ± 2.1 days (Fig. 1).

Post-operative esophagram was performed in 2147 (66%) patients. Patients who had an esophagram compared with those who did not had similar age at admission, gender distribution, and age at EA repair (Table 2). However, patients who underwent an esophagram had a significantly higher birthweight (2591 ± 15 g versus 2392 ± 25 g, $p < 0.001$) and a shorter LOS (46.9 ± 1.1 versus 65.7 ± 2.2, $p < 0.001$). A reoperation in the first 30 days was required in 42 (2%) patients who had an esophagram and in 48 (4%) patients who did not. There was no significant difference in placement of a chest tube, pneumothorax, or pleural effusion between our two groups. Further, there was no difference in the need for an esophageal dilation or a cervical esophagostomy in these patients.

Interestingly, there was a higher rate of mortality in patients who did not have an esophagram. A subset analysis was performed to determine the cause of increased mortality in this group. We found that those patients who died without an esophagram had a significantly lower birthweight (1806 ± 68.6 g versus 2471 ± 25.7 g, $p < 0.001$) and higher rate of extracorporeal membrane oxygenation (ECMO) (10.7% versus 1%, $p < 0.001$). Additionally, 43.5% died greater than 30 days post-operatively. This suggests that the subset of patients who died without an esophagram may have had significant co-morbidities and may have died due to complications unrelated to their EA repair.

Although it appeared that use of routine esophagram did not affect patient outcomes, we further evaluated patients who