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# The radiological assessment of colonic replacement of the esophagus in children: A review of 43 cases

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ABSTRACT

*Purpose:* To define the characteristic radiological features following colonic replacement of the esophagus in children.

*Materials and methods:* The upper gastro-intestinal contrast studies of 43 patients who underwent colonic replacement of the esophagus at our pediatric surgery unit were available for analysis. UGI contrast studies were performed routinely in the post-surgical period in 17 cases (first asymptomatic group), while the rest of contrast studies (26) belonged to a second group of out-patients complaining of dysphagia (18) or dyspepsia (8) following colonic replacement of the esophagus. Based on our observations, we proposed a grading system to describe the degree of colonic redundancy in the thorax.

*Results:* Redundancy of the colonic conduit in the thoracic cavity was a common radiological finding (62.8%). The redundancy was mild (grade 1) in 18 patients, moderate (grade 2) in eight, and severe (grade 3) in only one patient. In 88.9%, the redundancy was in the right hemi-thorax.

Patients presenting with postoperative dysphagia had a stricture at the site of the esophago-colic anastomosis in the neck, which should be differentiated from other sites of anatomical narrowing at the inlet and outlet of the thoracic cavity.

Gastro-colic reflux was common among patients who underwent colonic replacement of the esophagus without an anti-reflux procedure.

*Conclusion:* Colonic replacement of the esophagus in children results in considerable anatomical alterations. Knowledge about the normal post-surgical changes and imaging features of the commonly encountered complications can increase the diagnostic confidence among radiologists and clinicians when dealing with these cases.



## 1. Introduction

The esophagus is the best conduit for food and fluids to the stomach, and every effort should be exhausted to keep children with their native esophagus. However, there are certain circumstances when esophageal replacement in children becomes unavoidable: long gap esophageal atresia, and resistant corrosive strictures [1]. In 1911, the colon was first introduced as a substitute for the esophagus [2,3]; and in our pediatric surgery unit, the colon has been used to replace the esophagus since 1972 [4,5]. The procedure has been subjected to a continuous process of technical evolution starting by the historical subcutaneous placement of the colonic conduit [6], trans-pleural retro-hilar route [7], posterior mediastinal 'trans-hiatal' route [8], and lastly the anterior retro-sternal colon bypass (which is considered our preferred technique at the present time) [9].

There are two common complaints (complications) following colonic replacement of the esophagus: the first is usually related to mechanical obstruction 'stricture' at the site of esophago-colic anastomosis in the neck causing dysphagia; and the second is a functional problem related to the mechanism of gastric emptying and regurgitation (reflux) of gastric contents into the colonic conduit [10,11]. An upper gastrointestinal (UGI) contrast study is the

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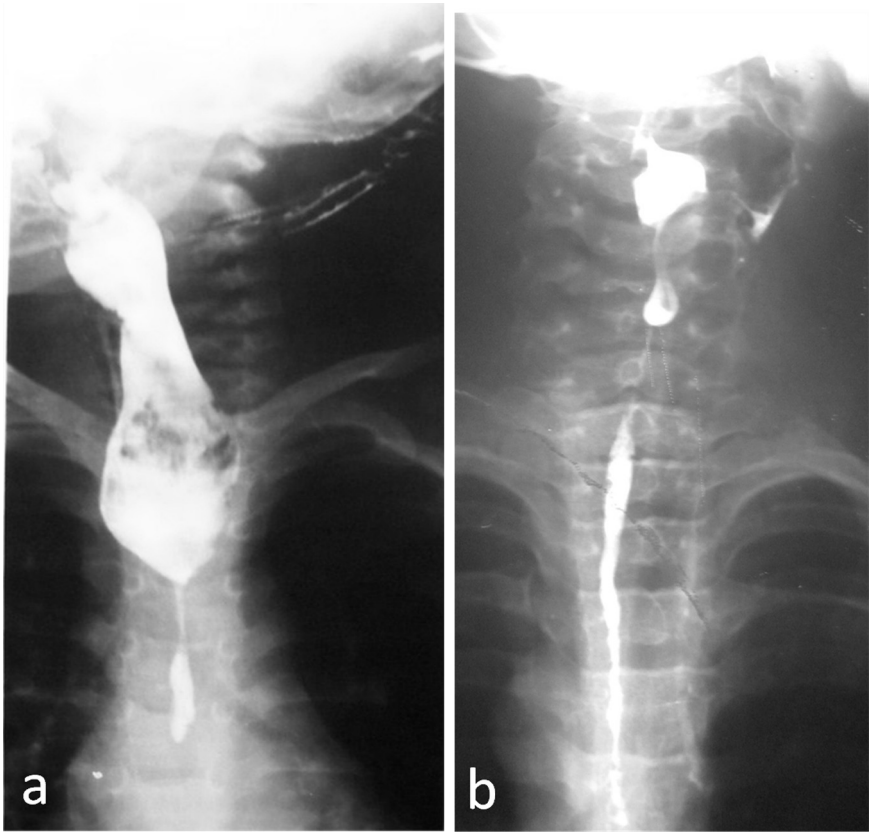


**Fig. 1.** Barium swallow of children with post-corrosive esophageal strictures for assessment before esophageal replacement. (a) Stricture in the mid-esophagus with a patent proximal esophagus suitable for the usual esophago-colic anastomosis in the neck. (b) A higher stricture in the proximal esophagus that would necessitate a higher anastomosis (pharyngeo-colic).

first-line investigation; however, other imaging modalities (CT and MRI) may be of value [12].

The non-anatomical placement of the esophageal substitute can represent a source of confusion among radiologists and clinicians. The aim of this study is to define the characteristic radiological features of the commonly encountered complications as well as the normal appearance following colonic replacement of the esophagus in children. This may help to improve the diagnostic confidence when dealing with these cases.

## 2. Materials and methods

Between January 2013 and April 2015, 23 children underwent colonic replacement of the esophagus at our pediatric surgery unit. The indication for operation was either corrosive strictures or long gap esophageal atresia. UGI contrast studies were performed in some of these patients routinely in the post-surgical period (first group). Also, UGI contrast studies were performed in another group referred from our outpatient clinic, who presented with dysphagia or dyspepsia following previous colonic replacement of the esophagus (second group). The UGI contrast and other radiological studies of both groups were collected, and retrospectively analyzed.

Pediatric patients who undergo esophageal replacement require radiological assessment throughout the different stages of the procedure: pre-operative, post-operative, and in the follow up.

### 2.1. Pre-operative imaging

For a case with long-gap esophageal atresia, an echo-cardiogram and renal ultrasound are performed to screen for possible associating anomalies. The patient undergoes esophagostomy and feeding gastrostomy at birth, to be scheduled later for esophageal replacement (usually at 9–12 months of age).

For patients with post-corrosive esophageal strictures, the pre-operative esophagogram is important to examine for the patency and degree of scarring of the proximal esophagus (Fig. 1). Usually, the colonic conduit is anastomosed with the proximal esophagus in the neck (esophago-colic anastomosis) to bypass a mid or lower esophageal strictures. A scared proximal esophagus should be an indication to shift for a higher-level anastomosis (pharyngeo-colic); otherwise, dysphagia will persist after the esophageal replacement. Similarly, it is important to check for gastric emptying by a barium meal (with or without a follow-through study), especially with a history of acid ingestion that is known to cause antral scaring as well.

### 2.2. Early post-operative imaging

Plain chest X-ray immediately after the colon bypass procedure is essential to check for complete lung inflation (Fig. 2), and for the position of the intravenous central line (if present). At the eighth to tenth post-operative day, a water-soluble esophagogram may be requested to check for any possible leakage at the esophago-colic anastomosis before starting oral intake.

### 2.3. Imaging in the follow-up

An UGI contrast study is the investigation of choice for evaluating both the anatomical and functional results following an esophageal replacement procedure. This includes either a barium swallow, meal, or follow-through, according to the patient's complaint. For uncooperative younger children, it may be necessary