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Swallowing outcomes in children after slide tracheoplasty

Alexandra J. Stewart[b,*], Colin R. Butler[a], Nagarajan Muthialu[a], Debbie Sell[b], Joseph Marchant[b], Richard J.D. Hewitt[a], Martin J. Elliott[a]

[a] The National Service for Severe Tracheal Disease in Children, Great Ormond Street Hospital, Great Ormond Street, London, WC1N 3JH, UK
[b] Department of Speech and Language Therapy, Great Ormond Street Hospital, Great Ormond Street, London, WC1N 3JH, UK

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ABSTRACT

Introduction: Slide tracheoplasty is now considered gold standard treatment for long segment congenital tracheal stenosis. Outcomes are typically focused upon airway patency. Dysphagia is often reported in children undergoing cardiothoracic surgery, but not specifically after slide tracheoplasty. This study was carried out to describe the nature and prevalence of dysphagia following slide tracheoplasty for long segment congenital tracheal stenosis.

Methods: Retrospective case note review was conducted on a series of patients who underwent swallow evaluation following slide tracheoplasty between 2006 and 2014. A clinical swallow assessment was carried out by a Speech and Language Therapist with videofluoroscopic evaluation of swallowing where indicated. Logistic regression assessed the impact of gender, feeding history, weight, tracheal diameter, stenting and co-morbidities on the likelihood of having post-operative dysphagia.

Results: 43 out of 83 slide tracheoplasty patients underwent swallow evaluation. Dysphagia was identified in 30 (70%) of 43 patients. Videofluoroscopy was undertaken in 22 of these patients. All patients who had a videofluoroscopy presented with altered swallow physiology. Aspiration risk was confirmed in 15 patients with frank aspiration seen in 9. Pre-operative history of dysphagia was present in 9 patients. There were two cases of vocal fold palsy. The presence of a stent was the strongest predictor of post-operative dysphagia with an odds ratio of 10.6 (95% CI 1.2–92.8).

Conclusions: This study documents a high prevalence of post-operative dysphagia in a pediatric population following slide tracheoplasty. In most cases there was no history suggestive of dysphagia pre-operatively. Swallowing needs to be assessed after slide tracheoplasty and longitudinal studies are required.

1. Introduction

Long segment congenital tracheal stenosis (LSCTS) is a rare, life-threatening condition, usually presenting in the first year of life, associated with the presence of complete cartilaginous rings in the trachea [1–3]. Several surgical treatments have been proposed in the past, including patch tracheoplasty [4], augmentation with costal cartilage [5] or tracheal autograft [6]. Morbidity and mortality were high and follow up short [7]. Slide tracheoplasty (STP) has now become the treatment of choice, providing lower mortality, morbidity and cost of care [1], [3].

Dysphagia has been frequently described in children undergoing thoracic surgery [8–14] with and without vocal cord paralysis [8,11–15]. There are no reports of dysphagia following STP or other surgical repair of LSCTS in the literature, despite the potential risk to both vocal fold innervation and the intimate morphologic relationship between the shortened trachea and the oesophagus. The identification of dysphagia in children undergoing STP is of clinical importance as secondary aspiration can occur and is a cause of recurrent pneumonia [16]. Silent aspiration, where the normal protective cough reflex is absent, is even more important to identify, so to prevent chronic lung parenchyma damage [17–19].

Our clinical observations in children undergoing swallow evaluation has suggested children have a degree of dysphagia leading to an increased aspiration risk. We describe swallowing outcomes in a consecutive series of children who underwent swallow assessment following surgical repair for congenital tracheal stenosis between 2006 and 2014.

2. Materials and methods

The project was registered with the hospital's Research and

* Corresponding author.
E-mail address: alex.stewart@gosh.nhs.uk (A.J. Stewart).

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Development department. Institutional review determined that ethical approval was not required due to the retrospective case note review methodology. Case note review for 43 consecutively referred children undergoing STP and Speech and Language Therapy swallow assessment between June 2006 and May 2014 was conducted. Forty patients underwent STP over the same period but were not referred to Speech and Language Therapy. Seven of these patients died following surgery. We present findings from the swallow assessment cohort only (n = 43).

2.1. Surgical procedure

Slide tracheoplasty was performed as previously described [20]. Briefly all operations were via a median sternotomy with mobilization of the trachea and a slide tracheoplasty performed over the stenosed segment. Where possible, associated cardiopulmonary anomalies were corrected at the same time. All operations were performed on cardiopulmonary bypass.

2.2. Clinical swallow assessment

Clinical swallow assessments were carried out by a specialist pediatric Speech and Language Therapist and involved the following:

(1) *Feeding history*: Parental information was gathered regarding feeding method, length of mealtimes/feeds, growth, coughing, stridor or other changes to respiration during or after feeding and previous chest infections.
(2) *Dysphonia screening assessment:* An auditory perceptual assessment of voice and/or cry was carried out to screen for dysphonia. All children underwent routine endoscopic airway evaluation (bronchoscopy ± microlaryngobronchoscopy). Further dynamic vocal fold evaluation using flexible nasendoscopy or ultrasound was conducted if dysphonia was identified.
(3) *Swallow assessment:* This involved observation of secretion management and spontaneous saliva swallows. If secretion management was adequate, observational swallow assessment coupled with cervical auscultation on age appropriate food/fluid was carried out. Table 1 lists the clinical indicators used to determine the presence of aspiration risk related to dysphagia [21].

2.3. Videofluoroscopy swallow study (VFSS)

Videofluoroscopy was carried out when indicators of aspiration risk were identified on clinical swallow assessment. Where there were overt signs of aspiration, a VFSS was contraindicated. Videofluoroscopy was carried out jointly by a Pediatric Radiologist and a Speech and Language Therapist. A fluoroscopy unit (Siemens Polystar digital unit-Siemens AG, Erlangen, Germany) connected to a high definition medical quality DVD recorder was used. Studies were undertaken according to the hospital's VFSS protocol [22]. Lateral images were obtained at 15 pulses/second. Each patient was given food and/or liquid boluses mixed with barium sulphate contrast (EZPaque 100% wpv). Where aspiration or penetration were seen on thin fluids, thickened fluids were assessed. Likewise, where aspiration risk was identified on thickened fluids, puree consistency solids were assessed if age appropriate. Fatigue testing was included in all studies. The VFSS was discontinued once the Radiologist and SLT agreed that the child had taken sufficient volume for the goals of study to be achieved [22].

Table 1
Clinical indicators of aspiration risk.

Coughing or choking during swallowing
Inability to handle own oral secretions
Noisy, “wet” upper airway sounds after individual swallows or increasing noisiness over course of feeding
Multiple swallows to clear a single bolus
Apnea during swallowing
History of frequent upper-respiratory infections or pneumonias

Table 2
Co-morbidities.

Cardio-vascular anomalies	n	Non-cardiovascular anomalies	n
Tetralogy of Fallot	4	Trisomy 21	2
Left pulmonary artery sling	24	Ex-prematurity	2
Atrial septal defect	4	Hydrocephalus	1
Ventricular septal defect	5	Duodenal atresia	1
Hypoplastic aortic arch	1	VACTERL	2
Subaortic stenosis	1	CHARGE association	1
Right aortic arch	1	Imperforate anus	3
Total anomalous pulmonary venous drainage	1	Single lung	2
Absent left pulmonary artery	1		
Vascular ring	1		

2.4. Statistical analysis

Data were analysed using SPSS version 21.0 (IBM-SPSS, Inc, Armonk, NY). Predictive modelling was conducted using logistic regression. Gender, pre-operative report (history) of dysphagia, weight, tracheal diameter, stenting and co-morbidities (extracardiac, intracardiac and non cardiac) were the independent variables analysed. Due to the small numbers identified with vocal fold palsy this was not included in the logistic regression model.

3. Results

Forty three patients (23 male), with a median age of 6 months (range 0.16–35 months) underwent clinical swallow assessment following STP. Comorbidities are outlined in Table 2. Eighteen patients had an associated intracardiac pathology, 11 of which were repaired at the time of STP. Twenty eight patients had an extracardiac pathology, 25 of which were repaired at the time of STP. Seven patients had no associated cardiac pathology.

3.1. Clinical swallow assessment

3.1.1. Pre-operative feeding history

Only one patient was non-orally fed pre-operatively. A history of consistent coughing during oral feeds was reported in 9 patients (21%), one of whom was admitted to pediatric intensive care with aspiration related respiratory infection pre-STP. Eight patients (19%) had a history of vomiting with feeding. One underwent gastrostomy insertion and Nissen's fundoplication 2 years prior to STP but was fully orally fed immediately prior to STP.

3.1.2. Clinical swallow assessment

A clinical swallow assessment was carried out a median of 13 days post-operatively (range 2–265). Variability existed due to length of post-operative intubation and timing of referral to Speech and Language Therapy.

Dysphagia was identified on clinical swallow assessment in 30 of 43 patients (70%). Clinical indicators of swallow dysfunction were: cough (25 patients, 58%), wet breath sounds (18 patients, 42%), multiple swallows (4 patients, 9%) and general poor swallow coordination (4 patients, 9%). One patient was identified with disorganised feeding secondary to gastro-esophageal reflux but did not present with clinical indicators of pharyngeal stage dysphagia.

3.1.3. Perceptual voice assessment

Post-operative dysphonia was evident in five patients. This was evaluated endoscopically in 4 patients and via laryngeal ultrasound