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A standardised investigative strategy prior to revisional oesophageal surgery in children: High incidence of unexpected findings

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Abstract

Background/Purpose: Revisional oesophageal reconstructive surgery carries uncommon and unusual risks related to previous surgery. To provide maximum anatomical detail and facilitate successful outcome, we report a standardised pre-operative investigative strategy for all such patients.

Methods: Prospective 8-month cohort study following the introduction of this strategy. All patients underwent high resolution thoracic contrast CT scan and micro-laryngo-bronchoscopy by a paediatric ENT surgeon in addition to upper gastrointestinal contrast study, oesophagoscopy, and echocardiogram.

Results: Seven children (median age 5.6 months [range 2.2–60]) completed the pathway. Four were referred with recurrence of a previously divided tracheo-oesophageal fistula (3 congenital, 1 acquired) and 3 (all with oesophagostomy) for oesophageal replacement for congenital isolated oesophageal atresia (OA, n = 1) and failed repair of OA with distal TOF with wide gap (n = 2). Overall, unanticipated findings were demonstrated in 6/7 children and comprised severe tracheomalacia and right main bronchus stenosis requiring aortopexy (n = 1), vocal cord palsy (n = 2), extensive mediastinal rotation (n = 1), proximal tracheal diverticulum (n = 1), severe subglottic stenosis requiring airway reconstruction (n = 1), proximal tracheal diverticulum (n = 1), right sided aortic arch (n = 1) and left sided aortic arch (previously reported to be right sided, n = 1).

Conclusions: This standardised approach for this complex group of patients reveals a high incidence of unexpected anatomical and functional anomalies with significant surgical and possible medico-legal implications. We recommend these investigations during the pre-operative work-up prior to all revisional oesophageal surgery.

When compared with primary oesophageal surgery, revision surgery is technically more difficult and carries higher operative risks. These are most commonly the result of anatomical distortion from operative scarring and obliteration of normal tissue planes and appearance. Children requiring

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revisional surgery following failed or complicated repair of congenital or acquired oesophageal structural abnormalities are often referred to tertiary referral centres. As a result, uncertainty is introduced which may increase the risk of subsequent surgical complications. The surgeon is reliant on second-hand information regarding the original anatomy, and the precise nature of any previous surgery may be unclear.

We have recently encountered a number of patients referred for revisional oesophageal surgery for a variety of indications. As a result of adverse outcome in 2 of these patients we introduced a standardised investigative pathway within our institution. The aim was to improve our knowledge of the pre-operative anatomy and function in these patients in order to reduce operative misadventure and post-operative complications. Herein we describe our investigative pathway and our initial findings following its implementation.

1. Methods

Our current investigative pathway has 3 stages. Firstly we perform whatever investigations are clinically indicated to confirm the nature of the abnormality for which the patient has been referred. On occasion, clinical examination and review of the radiological investigations that arrive with the child are all that is necessary. However most will need further targeted radiological imaging such as a prone tube oesophagogram in the case of suspected recurrent tracheo-oesophageal fistula. All children undergo rigid or flexible oesophagoscopy and echocardiogram.

We then perform a high resolution computed tomography (CT) scan of the chest with intravenous contrast under general anaesthesia if necessary. The aim of this CT scan is to provide anatomical detail of the thoracic vascular anatomy, detail of the oesophageal and airway anatomy and to identify the presence of pulmonary disease.

Finally an endoscopic examination of the airway is performed by an experienced paediatric otorhinolaryngologist with the general paediatric surgical team in attendance. The specific purpose of this examination is to identify structural or dynamic airway abnormalities including significant tracheomalacia, the presence of a tracheo-oesophageal fistula and its anatomical location and to assess vocal cord movement.

We collected data prospectively over the 8 month period up to December 2011 and report all patients referred for revisional oesophageal surgery during this time period. We firstly report brief details of 2 patients on whom we operated prior to this and who had adverse outcomes. Our current investigative pathway was devised following the treatment of these initial 2 patients.

2. Results

The first child was referred at the age of 6 months. At the age of 1½ months he had suffered an oesophageal injury due to impaction of a battery in the upper oesophagus. The battery was retrieved from the oesophagus at an emergency open operation and a cervical oesophagostomy fashioned because of damage to the oesophageal wall. A gastrostomy was created to allow feeding. The child was referred to our centre for oesophageal reconstruction. Following assessment of oesophageal length, oesophageal reconstruction was performed. Post-operatively the child was noted to have a hoarse voice and subsequent laryngoscopy revealed evidence of left recurrent laryngeal nerve (RLN) palsy. It was unclear if this had been present prior to surgery. The hoarseness settled.

A second child was referred for oesophageal replacement surgery at the age of 18 months having been born preterm at 34 weeks gestation with oesophageal atresia and distal tracheo-oesophageal fistula, an anorectal malformation and VACTERL association. Following a complicated operative course, a gastrostomy and cervical oesophagostomy were *in situ* at the time of referral. In addition there had been a previous episode of cardiac arrest requiring intensive care treatment and an episode of sepsis-related acute renal failure requiring haemofiltration. A gastric transposition was successfully performed. Twenty four hours following surgery signs of superior vena cava (SVC) obstruction developed with acute cardiorespiratory compromise. Echocardiography revealed a markedly narrowed SVC with thrombus and no flow. In view of further deterioration an attempt was made to commence extra-corporeal life support but it was not possible to achieve venous cannulation due to stenosis in multiple vessels. The child died.

Following the treatment of these two children we derived a standardised investigative pathway for all children referred for revisional oesophageal surgery. We have evaluated 7 children in this manner. Demographic and clinical details of these children are shown in Table 1. The combination of contrast CT scan and endoscopic evaluation or the airway has revealed a high incidence of abnormalities which were not suspected clinically but which have had clinical, surgical and in some cases potentially medico-legal implications. The abnormalities detected and subsequent clinical course of each child are detailed in Table 1.

All children were orally fed following surgery. Overall unexpected findings were detected in 6 of the 7 patients. The most significant airway anomaly detected was critical subglottic stenosis in child C. The airway would accept only a size 2.5 endotracheal tube at the age of 6 months. He required larnygotracheal reconstruction prior to oesophageal replacement surgery as it was deemed unsafe to proceed with major oesophageal surgery requiring a period of post-operative ventilation with a critically narrow airway.

Examples of the other abnormalities detected are shown in the Figures. Fig. 1 shows pulmonary disease secondary to chronic aspiration alongside significant rotation of the mediastinal anatomy such that the trachea lies lateral and to the right side of the oesophagus in child A who had previously undergone division of a congenital trachea-oesophageal fistula