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Laryngotracheal reconstruction and cricotracheal resection in children: Recent experience at Great Ormond Street Hospital

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ABSTRACT

Background: Surgery for paediatric airway stenosis is constantly evolving. Surgery is the primary treatment modality via either an open or endoscopic approach. The objective of this study was to review the results of laryngotracheal reconstruction (LTR) and cricotracheal resection (CTR) procedures performed at Great Ormond Street Hospital over the past 10 years.

Methods: All patients who underwent open airway reconstruction surgery from January 2000 to December 2010 were included in this study. Patients treated entirely endoscopically were excluded. The data was collected using the electronic operating theatre database and the discharge summary database.

Results: Complete data was available for 199 patients who underwent open airway reconstruction from January 2000 to December 2010. The procedures included single stage LTR (57, 28.6%), two stage LTR (115, 57.7%), single-stage stomal reconstruction (14), single-stage CTR (8) and two-stage CTR (5). The diagnoses at the initial airway endoscopy were laryngeal web (22), subglottic stenosis (151), posterior glottic stenosis (9), suprastomal collapse (15), supraglottic stenosis (1) and tracheal stenosis (1). For those with subglottic stenosis, the stenosis was grade 1 in 1 patient, grade 2 in 26 patients, grade 3 in 117 patients and grade 4 in 6 patients. At the completion of intervention 175/199 (87.9%) patients reported improvement in their symptoms. Amongst the subglottic stenosis group, post LTR success was achieved in 100% with grade 1 stenosis, 92.3% with grade 2 stenosis, 88.1% in grade 3 stenosis and 83.3% in grade 4 stenosis. Of the two-stage LTR procedures, 100/115 (86.9%) had their tracheostomy removed and 15/115 (13.1%) have failed decannulation. Of the single-stage LTR group, 50/57 (87.7%) patients were better both on airway examination and symptomatically postoperatively. Of the single-stage stomal reconstruction group, 13/14 (92.8%) were better symptomatically and on airway examination. Patients who underwent single-stage CTR had a better airway on examination and were symptomatically improved in all cases (8/8). For the patients who underwent two stage CTR, the tracheostomy was removed in 3/5 (60%) and retained in 2/5 (40%). For the whole group, 15/199 (7.5%) patients underwent a revision LTR. On further analysis, revision LTR was required in 4/57 (7.1%) single-stage LTR, 9/115 (7.8%) two-stage LTR, 1/5 (20%) two-stage CTR and 1/8 (12.5%) single-stage CTR. In this study complications occurred in 13/199 (6.5%).

Conclusions: Subglottic stenosis in children needs to be approached on the basis of the nature and severity of stenosis and the individual patient's general health. Good outcomes are achieved with both LTR and CTR. Good results are obtained both with single-stage and two-stage LTR, but restenosis remains a problem. An individual approach is required for treatment of paediatric airway stenosis to achieve good final outcomes. The overall success rate has increased only marginally in our institution over the last 20 years.

1. Introduction

The management of laryngotracheal stenosis (LTS) forms a significant part of the practice of the paediatric otolaryngologist. Surgery is the primary treatment modality via either an open or endoscopic approach. The two most common open procedures are laryngotracheal reconstruction (LTR) and partial cricotracheal resection (CTR). LTR involves splitting the cricoid cartilage and expanding the framework with a cartilage graft. Partial CTR involves segmental excision of the stenotic segment, preserving the posterior cricoid plate, and an end-to-end anastomosis [1]. The management of paediatric airway reconstruction has changed considerably since its introduction in the 1970s.

The purpose of this study is to present the results of surgery for LTS procedures performed at Great Ormond Street Hospital over the past 10 years, and contrast them with our previous 10-year series from the 1980s [2–4].

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2. Methods

This study was conducted in the Department of Paediatric Otolaryngology at Great Ormond Street Hospital for Children. All the patients who underwent open airway reconstructive surgery from January 2000 to December 2010 were included in this study. Patients treated entirely endoscopically were excluded, as were anterior cricoid split procedures. The data was collected using the prospective electronic operating theatre database and the discharge summary database. The information collected included patient demographics, co-morbidities, severity of stenosis, level of stenosis, reason for the procedure, the nature of the operation, operative details, complications and the final outcomes. The subglottic stenosis was graded according to the Myer–Cotton grading system using an endotracheal tube to size the airway [5]. The outcomes measured included rate of decannulation for those patients who had a tracheostomy before the reconstruction, and airway endoscopy findings and symptomatic improvement for those who did not have a tracheostomy prior to the reconstruction.

Single-stage laryngotracheal/cricotracheal/stomal reconstruction was defined by the patient not having a tracheostomy tube in place at the conclusion of the procedure. This therefore includes patients who had their tracheostomy removed at the time of the surgery, and those who did not have a tracheostomy preoperatively. All these single-stage LTR/CTR/stomal reconstruction patients had a nasotracheal tube left in place at the end of the procedure for around 7 days and were monitored on the intensive care unit. Two-stage laryngotracheal/cricotracheal reconstruction was defined by the patient having a tracheostomy tube at the end of the procedure. All of these patients had a tracheostomy in place pre-operatively. The majority of patients undergoing two-stage LTR had a stent sited perioperatively held in place by a prolene transfixion suture. The stent was custom-made using an age-appropriate ivory portex endotracheal tube and removed endoscopically on average 4–6 weeks after placement.

3. Results

Complete data was available for 199 patients (122 male, 77 female) who underwent open airway reconstruction from January 2000 to December 2010. The procedures included single-stage LTR (57, 28.6%), two-stage LTR (115, 57.7%), single-stage stomal reconstruction (14), single-stage CTR (8) and two-stage CTR (5) (Fig. 1). The diagnoses at the initial airway endoscopy were laryngeal web (22), subglottic stenosis (151), posterior glottic stenosis (9), suprastomal collapse (15), supraglottic stenosis (1) and tracheal stenosis (1). For those with subglottic stenosis, the stenosis was grade 1 in 1 patient, grade 2 in 26 patients, grade 3 in 117 patients and grade 4 in 6 patients. The vast majority (159/199, 79.9%) of these patients had significant co-morbidities. The associated comorbidities in this varied group included cerebral palsy, chronic lung disease, CHARGE syndrome, tracheomalacia, bilateral and unilateral cord palsy, Fallot's tetrology, craniofacial abnormalities, reflux disease, Fraser syndrome, Di George syndrome, Larsen syndrome, velocardiofacial abnormality, laryngeal cleft, developmental delay, cricoarytenoid joint fixation, cerebral ischaemia, cardiac abnormalities and dwarfism. Sixty-seven were born prematurely, ranging from 23 weeks to 31 weeks at birth. The age at the time of operation varied from 9 months to 16 years. Most of the patients (173/199) were between 1 and 5 years of age at the time of operation. Amongst these 19 patients were less than 1 year age at time of operation, 49 patients between 1 and 2 years at operation, 33 between 2 and 3 years, 37 between 3 and 4 years and 35 between 4 and 5 years at the time of operation. In this group of patients, 160/199 (80.4%) had a tracheostomy prior to undergoing laryngotracheal reconstruction. The pathology was congenital in 47 and acquired in 152/199 patients.

Amongst the 57 single-stage LTR's, 11 (19.3%) had a tracheostomy reinserted at some stage after the procedure. One of the 14 single-stage stomal reconstructions and one of the 8 single-stage CTR's had the tracheostomy reinserted. Overall 13 of the 79 (16.5%) patients who underwent single-stage procedures had a tracheostomy reinserted.

Costal cartilage was the primary choice of graft material in this series. Of all the LTR/stomal reconstructions (186), the reconstruction was done with an isolated anterior graft in 91 cases, both anterior and posterior grafts in 61 cases, an anterior graft and posterior split in 26 cases and an isolated posterior graft in 8 cases.

In two-stage LTR/CTR procedures a custom-made stent (fashioned from an ivory portex endotracheal tube) was used in 113 of the 120 cases. A nasotracheal tube functioned as a stent in the single-stage procedures. No stent was used in 2 of the 5 two-stage CTR's and in 5 of the 115 two-stage LTR's. The stents were left in situ for between 3 and 8 weeks, with the majority used for 6 weeks. Nearly all of the patients who underwent two-stage LTR required further surgical intervention following their initial open operation, the common procedures being excision/laser ablation of a suprastomal granuloma (26 patients), removal of granulations (13 patients), balloon dilatation (29 patients) and closure of a tracheocutaneous fistula (31 patients).

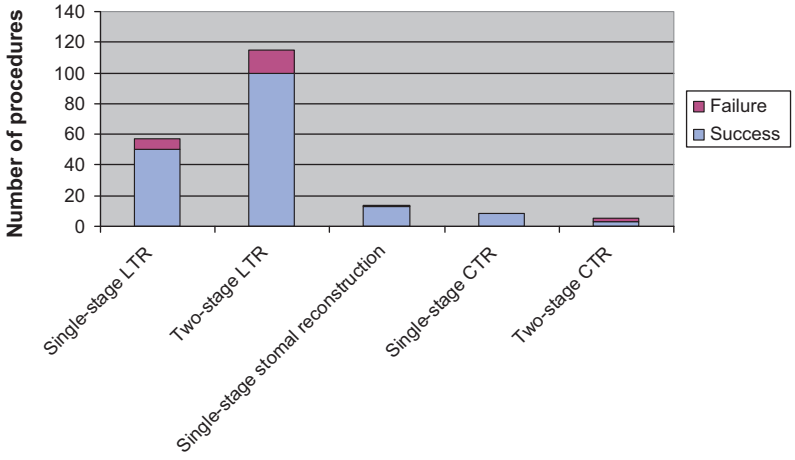

Fig. 1. Summary of results of all procedures.