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Laryngotracheal reconstruction for pediatric glotto-subglottic stenosis

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ABSTRACT

Background: The management of pediatric laryngotracheal stenosis (LTS) can be challenging, and laryngotracheal reconstruction (LTR) with cartilage interposition grafting remains the mainstay of surgical treatment for pediatric LTS in most experienced centers. The purpose of this study was to report the results of this procedure in a center where primary cricotracheal resection is frequently performed.
Methods: A retrospective chart review was performed on 45 patients who underwent LTR in our hospital between October 1997 and July 2012. Demographic characteristics and information on the preoperative status, stenosis, and operation were collected. Primary outcomes were measured as overall (ODR) and operation-specific (OSDR) decannulation rates and secondary outcomes as morbidity, mortality, and postoperative functional results.
Results: ODR and OSDR were 86.7% (39/45) and 66.7% (30/45), respectively. Re-stenosis was observed in 11/45 (24%) patients, all of whom were endoscopically or surgically treated. Revision surgery was performed in 10 patients, 6 for re-stenosis and 2 for peristomial tracheomalacia. Two children died of mucous obstruction of tracheostomy tube at 3 and 6 months postoperatively (4.4%). Respiratory, voice, and swallowing functions were excellent or good in 86, 75, and 84% of patients, respectively.
Conclusions: LTR for pediatric LTS has high decannulation rates with acceptable morbidity and mortality in selected patients. Most LTR procedures were double-stage for lower grade subglottic stenoses associated with glottic involvement that required stenting. Careful preoperative evaluation and adequate surgical indications are extremely important to achieve high decannulation rates.

1. Introduction

The management of pediatric laryngotracheal stenosis (LTS) remains challenging, and the number of centers where adequate treatment can be provided is still limited. Since the description of laryngotracheal reconstruction (LTR) with cartilage interposition grafting by Fearon and Cotton [1], LTR has become the mainstay of surgical treatment for pediatric LTS in most experienced centers.

Our group introduced partial cricotracheal resection (PCTR) in children for severe stenosis grades. This technique had previously been developed mainly in the adult population [2–4]. Considering its high success rates for grade III and IV subglottic stenosis (SGS), PCTR has been our preferred procedure for adequately selected patients [6]. However, LTR is still used in our center for several conditions, such as isolated posterior glottic stenosis (PGS), PGS combined with minor (Grade I or II) subglottic stenosis, revision surgery where further tracheal resection is impossible, or Grade I or II SGS.

Here we report our experience of LTR performed for pediatric LTS and present the results of this procedure in a center where PCTR is frequently performed.

2. Methods

Between October 1997 and July 2012, a total of 141 pediatric patients underwent surgical interventions (PCTR or LTR) for laryngeal or laryngotracheal stenosis at the Lausanne University Medical Center (CHUV), Lausanne, Switzerland. After approval by the Institutional Review Board of our institution, a retrospective chart review was performed on 45 patients who underwent LTR for pediatric LTS. Conditions other than benign cicatricial or congenital stenoses were excluded from the study. The data were collected from the patients' charts, and endoscopic and surgical reports, and the registration of the data on follow-up was closed at the end of February 2013. Data collection included the following: demographic characteristics (sex, age), preoperative clinical data (etiology of the stenosis, previous treatment(s), respiratory status, presence of comorbidities or congenital anomalies), pre-operative endoscopic assessment of the stenosis (location, grade according to the Cotton–Myer classification, glottic involvement, vocal cord

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mobility, cricoarytenoid ankylosis), operation data (single- vs. double-stage surgery, type of graft(s), size of the stent), morbidity and mortality, decannulation rates, time to decannulation (for double-stage LTR), and postoperative functional results (dyspnea, voice impairment, swallowing). Patient consent was waived because of the anonymity in the design of the study.

All the patients in this series underwent a laryngotracheoplasty with or without cartilage graft. Costal cartilage was used in all but 1 patient for whom cartilage of the thyroid ala was used anteriorly for a cricoid split procedure. Before 2001, a T-tube or silicon tube was used for stenting of the larynx after double-stage LTR. Since 2001, an LT mold prosthesis [7–9], developed by the senior author (PM), was used.

After single-stage LTR, the patients were intubated for 5–10 days under sedation with spontaneous respiration in the pediatric intensive care unit to stabilize the implanted cartilage graft. Extubation was performed under general anesthesia during endoscopic examination in the endoscopy suite with the help of specialized pediatric anesthetists. After double-stage LTR, the patients were not kept sedated. Antibiotics were given for 2 weeks to prevent graft infection. Endoscopy to check for complications was performed before discharge from the hospital. The laryngeal stent was left in place for 6 weeks to 3 months, depending on the degree and extent of the stenosis.

After stent removal, regular endoscopy was performed to check for post-operative complications, such as granulation tissue or re-stenosis, and if present, they were treated during the same session. Follow-up endoscopy was performed periodically for patients for at least 1–2 years after the surgery, depending on their condition.

Tracheostomy-dependent patients, patients awaiting decannulation, and those who were lost to follow-up were considered as decannulation failure. Overall and operation-specific decannulation rates (decannulation rate without revision surgery) were compared with rates of primary and salvage surgery, etiology of the stenosis, Cotton–Myers grade, and the location of the stenosis.

Data were expressed as mean with range and median. Chi-square tests were performed to compare decannulation rates between groups.

3. Results

3.1. Preoperative and operative data (Table 1)

Of the 141 pediatric patients who underwent open surgery for laryngotracheal stenosis in our institution during the study period, 45 pediatric patients (22 male and 23 female; mean age, 4.7 years) underwent a LTR. Mean follow-up was 17.6 (range, 2–126) months. Forty-one (91%) patients were tracheostomy-dependent before being referred to our institution and 22 (49%) patients were treated previously at other institutions. In all 45 patients, LTR was the primary procedure performed in our institution. Severe anomalies were observed in 15 (33%) patients (Table 1). The stenoses were of acquired or mixed origin (congenital stenosis aggravated by 1 or several intubations) in 35 (78%) and congenital in 10 (22%) patients (Table 1). The stenosis was purely glottic in 5 and involved the subglottis in 40 patients (Grade I in 4, II in 12, III in 21, and IV in 3). Nine patients had isolated subglottic stenosis, and 31 patients had glotto-subglottic stenosis. All 5 patients with pure glottic stenosis demonstrated posterior glottic stenosis. Abnormal vocal cord mobility was observed in 39 (87%) patients. A single-stage LTR was performed in 4 and a double-stage in 41 patients. All 4 patients who underwent single-stage LTR had isolated subglottic stenosis (grade II in 3 and III in 1) without glottic involvement. A single posterior graft was used in 17 and a single anterior graft in 7 patients. A double graft (anterior and posterior) was used in the remaining 16 patients. A posterior cricoid split alone without graft was performed in 5 patients. In these 5 patients without cartilage graft interposition, 3 recurred and finally needed revision surgery.

Table 1
Preoperative and operative informations.

Preoperative	
Age	Mean: 4.7 years (2 months–15 years)
Sex	Male: 22/Female: 23
Previous treatment	
No	23
Endoscopic	13
Surgical	9
Dyspnea	
No	2
Dyspnea at effort	1
Dyspnea at rest	1
Tracheostomized	41
Associated anomaly	
No	30
Cardiac	4
Respiratory	2
Neurologic	2
Sydromatic	4
Others	3
Stenosis	
Etiology	
Congenital	10
Acquired	26
Mixed	9
Location	
Glottic	5
Subglottic	9
Glotto-subglottic	31
Grade	
Isolated glottic	5
I	4
II	12
III	21
IV	3
Vocal fold mobility	
Normal	6
Limited abduction	14
Unilateral fixation	5
Bilateral fixation	20
Operation	
Operation stage	
Single	4
Double	41
Type of graft	
No graft	5
Anterior	7
Posterior	17
Anterior + posterior	16
Type of stent	
No	5
LT mold	32
T-tube	2
Others	6

3.2. Revision surgery and mortality

Re-stenosis was observed in 11 of 45 (24%) patients (Table 2). Two patients with recurrence of anterior web of the vocal cords were successfully treated endoscopically. Recurrent posterior glottic stenosis (PGS) was observed in 5 patients. Of those, 3 were treated endoscopically and 2 underwent a revision LTR. Recurrent PGS with subglottic stenosis was found in 4 patients. They were all treated surgically (LTR in 2 and PCTR in 2). Overall, revision surgery was performed in 10 (22%) patients, including the above-mentioned 2 PCTRs and 4 LTRs. Two patients needed