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Partial cricotracheal resection for pediatric subglottic stenosis: a single institution's experience in 60 cases

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Abstract In our study, 60 infants and children, each with a severe subglottic stenosis (SGS), underwent partial cricotracheal resection (PCTR) with primary thyrotracheal anastomosis. According to the Myer-Cotton classification, two were grade II, 41 were grade III and 17 were grade IV stenoses. Of the 60 patients, 57 (95%) are presently decannulated, and one patient sustained a complete restenosis. Two patients with better than 80% subglottic airways still are waiting for decannulation: one because of bilateral cricoarytenoid joint fixation and the second because of temporary stenting of the subglottis with a Montgomery T-tube. The rate of decannulation is 97% (36 of 37 cases) in primary PCTRs, 100% (13 of 13 cases) in salvage PCTRs for failed laryngotracheal reconstructions (LTR) and 70% (7 of 10 cases) in extended PCTRs (i.e., PCTR associated with an additional open-airway procedure).

Keywords Cricotracheal resection · Subglottic stenosis · Infants · Children

Introduction

In the pediatric age group, PCTR has slowly emerged as a superior alternative to LTR for the cure of severe grade III and IV SGS without glottic involvement. This technique has shown the same success rate in primary as well as in salvage surgery performed after failed LTRs or endoscopic treatments.

Debates continue about the respective indications for LTR versus PCTR when an additional airway procedure is required (i.e., extended PCTR according to Rutter and Cotton) [1]. This is typically the case in SGS combined with posterior glottic stenosis or fusion of the vocal cords. These latter glotto-subglottic stenoses can be very challenging and thus call for a two-stage procedure with stenting. Decannulation is then achieved in most cases within 1 year, and a second (open or endoscopic) procedure may be necessary for the cure of bilateral cricoarytenoid joint fixation.

We report here an update of our experiences with 60 PCTRs performed in infants and children (Table 1) [2, 3, 4].

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Materials and methods

Most of the patients were referred from foreign countries and were tracheotomy dependent or had severe dyspnea at rest. Associated malformations were present in 40% of the cases and were of medi-

Table 1 Preoperative data for 60 pediatric PCTRs

Sex	32 male	28 female
Age	≤1 year: 8 ≤3 years: 20 ≤8 years: 15 ≤16 years: 17	47% [2]
Referred cases		56/60 ~ 93%
Respiration		
Tracheotomy		46/60 ~ 77%
Severe dyspnea at rest		13/60 ~ 23%
Intubation		1/60
Voice		
Aphonia		33
Severe dysphonia		18
Normal voice		9
Associated malformations		24/60 ~40%
Cardiovascular		15/60
Trisomy 21		4/60
Other syndromes		5/60
Primary surgery		33/60 ~55%
Salvage surgery		27/60 ~45%
Failed LTRs		15
Failed endoscopic treatments		11
Failed PCTR		1

Table 2 Data of 60 SGS and vocal-cord mobility

Etiology		
Acquired	34	83% [2]
Mixed	16	
Congenital	8	
Other	2	
Grade (according to Myer-Cotton):		
I =	0	
II =	2	
III =	41	97% [2]
IV =	17	
Site		
Purely subglottic	36	
Glottis + subglottis	11	40% [3]
Transglottic	6	
Subglottis + trachea	7	
Vocal-cord mobility		
Normal	31	
Limited abduction	14	
Unilateral fixation	3	
Bilateral fixation	12	

Table 3 Operative data from 60 pediatric PCTRs

Single-stage PCTR	38/60 ~63%
Two-stage PCTR	22/60 ~37%
Type of surgery	
PCTR alone	42
PCTR + Rethi	7
PCTR + graft of buccal mucosa	2
PCTR + pedicled graft of membranous trachea	7 (1 Rethi)
PCTR + VC separation	4 (1 Rethi)
Extension of resection	
Cricoid only	11 cases
Cricoid + tracheal segment	49 cases
1 to 4 tracheal rings	30 cases
5 to 8 tracheal rings	19 cases

astinal origin in almost two-thirds of the cases. PCTR was used as salvage surgery after failed LTRs, endoscopic treatments or PCTR in somewhat less than 50% of the cases. Table 2 gives information on the main features of the stenoses and vocal-cord mobility. More than 80% of the SGS were acquired after intubation, sometimes combined with a previously asymptomatic minor congenital stenosis (mixed etiology). All cases but two were severe grade III or IV stenoses, and in 40% of the cases the SGS was combined with glottic involvement or significant tracheal damage. Abnormal vocal-cord mobility was seen in almost 50% of the cases.

A single-stage PCTR (with intraoperative resection of the tracheostoma) was done in 38 of 60 (63%) of the patients (Table 3). Two-stage PCTRs (22 of 60, approximately 37% of the cases) were used for SGS combined with posterior glottic stenosis or fusion of the vocal cords.

Results

Overall, 57 of the 60 (95%) patients are presently decannulated. One patient sustained a complete restenosis, and two patients still await decannulation despite a patent (>80% lumen) subglottic airway. All 38 patients who underwent a single-stage PCTR for a SGS without glottic involvement were decannulated within 3 weeks, except for one little girl who needed a temporary tracheotomy (Table 4).

Table 4 Extubation time after single-stage PCTRs (n=38)

Extubation time (in p.o. days)	No. of patients	%	
0	1	82% [3]	92% [4]
≤7	22		
≤10	8		97% [5]
≤15	4		
≤21	2		
≤90 (temporary tracheotomy)	1		

Table 5 Decannulation time after two-stage PCTRs (n=22)

Decannulation (in months)	No. of patients	%	
≤3	6	59% [2]	86% [3]
≤6	8		
≤12	6		
Awaiting decannulation	2		
Not decannulated	1		

Of the 22 patients who underwent a two-stage operation (i.e., PCTRs with tracheotomy), 19 (86%) were decannulated within 1 year (Table 5).

Revision surgery for a partial dehiscence of the anastomosis had to be performed in 3 of the 60 (5%) patients. There were no lesions of the recurrent laryngeal nerves, but we have to report one death from a massive broncho-aspiration in a baby with multiple malformations 6 months after the surgery.

Of the 57 patients, 46 (77%) show no exercise intolerance, 8 (14%) present some exertional dyspnea as a result of the limited abduction of the vocal cords, and 3 patients are not decannulated. Thirty-eight (64%) have a normal voice or a slight dysphonia, and 18 (30%) a moderate to severe dysphonia. The others await decannulation.

The postoperative follow-up is longer than 10 years in 11 children, with eight patients having reached adulthood; in all cases, the laryngotracheal development is normal.

Discussion

The respective indications of PCTR and LTR have been a matter of debate over the last years, but it is now generally accepted that PCTR represents the treatment of choice for severe grade III and IV SGS without glottic involvement as a primary or salvage surgery [5, 6, 7, 8].

In a recent review, the group of Cincinnati [1] reported that primary PCTRs were successful in 14 of 14 (100%) cases. When used as salvage surgery after failed LTRs, PCTR achieved a success rate of around 90% (19 of 21

decannulations), but results were less favorable (5 of 9 decannulations) in extended PCTRs (i.e., when PCTRs must be combined with an additional open-airway procedure).

The analysis of our 60 PTCRs in the same fashion are very similar. The rate of decannulation is 97% (36 of 37 cases) in primary PCTRs, 100% (13 of 13 cases) in salvage PCTRs after 12 failed LTRs and one failed PCTR and 70% (7 of 10 cases) in extended PCTRs.

In our experience, extended PCTR (i.e., PCTR with posterior cricoid split and costal-cartilage graft with a pedicled flap of membranous trachea) is still superior to LTR. The normal tracheal ring directly sutured to the thyroid cartilage helps stabilize the subglottic airway and prevents distortion of the larynx, while the pedicled membranous trachea offers coverage of the posterior costal-cartilage graft, thus ensuring a fully mucosalized subglottic airway. However, as in LTRs, stenting is necessary.

Conclusions

Until now, the reluctance to use PCTR for the treatment of SGS in infants and children has merely reflected the difficulty that otolaryngologists have had in changing the surgical concept of an enlargement LTR to that of a resection of the stenotic segment with end-to-end anastomosis. It is true that PCTR is more technically challenging than LTR and carries the risk of more serious complications, but it is the role of otolaryngology centers to develop the surgical skills that will provide the best care for all children.

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