Cricotracheal Resection with Hilar Release for Pediatric Airway Stenosis

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Abstract

Objective: Describe the use of intrathoracic release as an adjunct to cricotracheal resection for long-segment airway stenosis. Methods: Retrospective review of 16 patients who have undergone this procedure with emphasis on preoperative findings, operative technique, postoperative course and results. Results: Patients had stenosis from 4 tracheal rings to near complete tracheal stenosis. Ten of the patients had a high grade III stenosis. Five patients had a complete stenosis. One patient had long segment collapse. All patients were decanulated after a single airway procedure except for one patient who remains ventilator dependant but has now developed speech. There were no anastomic leaks or local complications. All patients returned to baseline swallowing function. Conclusion: Intrathoracic release is a valuable adjunct in the management of high-grade long-segment airway stenosis.

Introduction

Subglottic stenosis (SGS) remains a challenging surgical problem for the pediatric otolaryngologist. To treat SGS, pediatric airway reconstruction has evolved rapidly over the previous 30 years. Cricotracheal resection (CTR) has been described as an alternative and complimentary technique to laryngotracheal reconstruction (LTR). Anastomotic dehiscence remains a feared risk inherent to CTR not associated with LTR. Even when implementing hyoid release techniques,[1,2,3] if the extent of required tracheal resection is greater than about 5 rings of tracheal cartilage, a two-staged procedure is typically required to achieve ultimate decannulation. A principle to increase surgical success is creation of a tension-free anastomosis. To this end, suprahyoid, infrahyoid and hilar releases have been developed. Despite its ability to increase mobilization, hilar release has not been noted to be routinely used in the thoracic surgery literature.[4,5,6] To address these limitations, the current series puts forward the utilization of routine hilar release in long segment, high grade CTR as a means to diminish risk of dehiscence and make single-staged procedures permissible in most cases with an acceptable margin of added risk.

Methods

We reviewed the medical records of 16 children who underwent cricotracheal resection with hilar release by our pediatric thoracic airway team. The variables that were analyzed included age, sex, grade of stenosis, comorbidities, necessity of infrahyoid release, length of stay, decannulation status and complications. Our surgical approach for cricotracheal resection with hilar release is via a right posterolateral thoracotomy with division of the pulmonary ligaments and pericardium. The right and left mainstem bronchi, carina, and distal trachea are mobilized on their anterior and posterior surfaces, while preserving the lateral vascular attachments. Once these maneuvers have been accomplished, it is generally possible to advance the carina several centimeters. The cricotracheal portion is then performed as previously described. The trachea is separated from the esophagus and dissected into the thorax where the dissection will come in continuity with that obtained from the intrathoracic approach. The trachea is then divided and the stenotic portion of the trachea is resected to the level of healthy appearing mucosa along with the anterior portion of the cricoid. After identification of the inominate artery, two 2-0 sutures are placed para-midline to elevate and suspend the trachea to the manubrium. This prevents the divided trachea from retracting into the chest and maximizes the benefit from the thoracic release

Post operative management is a collaborative effort between the pediatric intensivists, pharmacists, physical therapists, occupational therapists, anesthesiologists, thoracic surgeons and otolaryngologists. Patients are kept sedated in the PICU for one week. The patient is then brought to the operating room for suture removal, Grillo stitch removal, direct laryngoscopy and bronchoscopy of the anastomosis and extubation. Following this the patient remains extubated with a modified Minerva brace in place to prevent neck hyperextension. Steroids and racemic epinephrine are given for 48 hours and the patient is weaned from sedatives. Weekly endoscopies are performed with intermittent laser treatment of granulation tissue as needed until the airway has stabilized.

Results

Sex	Age	Grade of stenosis	Severe comorbities	Infrahyoid release	Length of resection excluding cricoid	Decannulation
M	13 months	high III	congenital neuroblastoma, GERD	no	5 rings	yes
M	16 months	high III	ASD, VSD, brachial plexopathy	no	6 rings	yes
F	18 months	high III	25 week prematurity, BPD	no	5 rings	yes
M	27 months	high III	24 week prematurity, BPD, ASD	no	6 rings	yes
M	28 months	high III	VACTERL, left hypoplastic heart	no	5 rings	yes
F	28 months	high III	25 week prematurity, BPD	no	5 rings	yes
F	34 months	high III	25 week prematurity, BPD, bronchomalacia, GERD	no	5 rings	yes
F	34 months	high III	27 week prematurity, BPD, cerebellar hemorrhage, CP, ASD	yes	5 rings	yes
F	8 years	high III	Omphalocele	yes	11 rings	yes
F	15 years	high III	Down syndrome, cor pulmonale, asthma, ASD	no	7 rings	yes
F	3 years	IV	24 week prematurity, BPD	yes	all but 2.2 cm	yes
F	3 years	IV	MVA, quadriplegic, vent dependent, seizures	yes	4 rings	no
F	4 years	IV	28 week prematurity BPD previous LTR, vocal cord paralysis, GERD	no	6 rings	yes
F	14 years	IV	MVA	yes	4 rings	yes
F	17 years	IV	MVA	no	4 cm	yes
F	4 years	long segment malacia	26 week prematurity BPD previous LTR, GERD	no	5 rings	yes

Table 1. Description of children who underwent cricotracheal resection with hilar release. (Abbreviations: ASD = atrial septal defect, BPD = bronchopulmonary dysplasia, CP = cerebral palsy, GERD = gastroesophageal reflux disease, VSD = ventricular septal defect)

Complications	No.	Percent
Reconstructive		
Failure to decannulate	0*	0
Anastomotic dehiscence	0	0
Pulmonary		
Pneumonia	6	35
Pneumothorax	3	18
Chylothorax	1	6
Hernia	1	6
Paralyzed diaphragm	2	12
Hiatal hernia	1	6
Other		
Seizure	1	6
Pressure ulcer	3	18
Self extubation	1	6
Deep venous thrombosis	1	6
C. difficile infection	1	6
Reintubation	1	6
Number of patients with complication	13	76
Number of complications requiring reoperations	6	35
Plication	1	6
Temporary tracheotomy	1	6
Pleurodesis	2	12
Gastric tube	2	12

Table 2. List of complications seen after cricotracheal resection with hilar release.
* - Note that one ventilator-dependant patient was not decannulated but has had her speech restored.

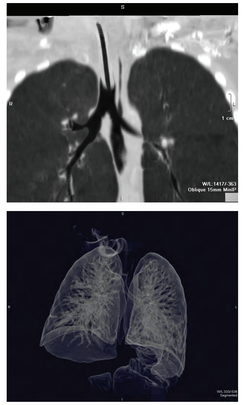

Figure 1. Example of patient with grade 4 subglottic stenosis and long-segment tracheal stenosis.

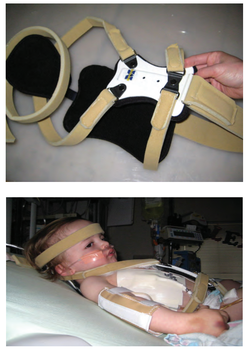

Figure 2. Minerva brace used postoperatively to prevent neck extension.

Discussion

Cricotracheal resection has become well-established in the surgical armamentarium for treatment of pediatric subglottic stenosis. Mounting experience favors the use of CTR for high grade stenosis. Decannulation rates of >90% for grades III and IV stenosis are common.[7,8] Our results compare favorably to those of others, with decannulation of all patients except for a quadriplegic child who continues to require mechanical ventilation but is now able to talk. All of our patients had long segment, high grade stenosis or long-segment tracheomalacia.

A most serious surgical complication reported in other series is dehiscence of the thyrotracheal anastamosis.[7,9,10] We routinely take several measures to prevent this complication, including hilar release, suprahyoid release, and the application of several anchoring sutures to provide a tension-free closure. We now routinely avoid infrahyoid release. In addition, we have developed an anchoring stitch which tacks the distal tracheal segment to the manubrium to prevent tracheal retraction into the chest, maximizes the benefit from the intrathoracic release, and facilitates closure of the anastomosis. The use of fibrin glue provides additional insurance against anastomotic leak. With these measures, we had no anastomotic leak or dehiscence in our series.

We had a low complication rate with the use of the hilar release, though we did have several patients with post-operative pneumothorax and chylothorax, most of which were treated conservatively. One complication that has been described by others is temporary post-operative swallowing dysfunction. All of our patients had nasogastric tubes placed in the immediate post-operative period. However, prolonged swallowing dysfunction was uncommon, with only one patient requiring gastrostomy tube placement for silent aspiration of thin liquids.

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