Surgical Management of Distal Tracheal Stenosis in Children
David Valencia, M.D.2, James Sidman, M.D.1,2, Timothy Lander, M.D.1,2, Robert Tibesar, M.D.1,2, David Overman, M.D.1, and Frank Moga, M.D.1

1Children’s Hospitals and Clinics of Minnesota
2Department of Otolaryngology–Head and Neck Surgery, University of Minnesota

Abstract

Objectives. 1) Describe the long term outcomes of tracheoplasty for distal tracheal stenosis, 2) demonstrate the utility of cardiopulmonary bypass for intraoperative airway management, and 3) compare perioperative morbidity and mortality of slide tracheoplasty for distal tracheal stenosis to costochondral graft and resection with end-to-end anastomosis. Methods. Retrospective chart review. Setting. Tertiary care children’s hospital. Design. Retrospective chart review (n=2009) of all patients undergoing tracheoplasty for distal obstruction and requiring cardiopulmonary bypass for intraoperative airway management. Results. Eleven patients, ages 1 month to 12 years, were identified. Four patients underwent slide tracheoplasty, 2 end-to-end anastomosis, and costochondral graft. Average cardiopulmonary bypass time was 120, 60, and 63 minutes. The only complication of cardiopulmonary bypass was one supraventricular tachycardia. There was no late death due to airway obstruction following repair of severe cardiac anomalies. The number of bronchoscopies required for resolution of granulation tissue in the slide tracheoplasty and end-to-end anastomosis groups were significantly less than for the tracheoplasty group. Three patients in the tracheoplasty group required tracheostomy and one remained tracheostomy-dependent at last follow up. None in the slide tracheoplasty or end-to-end anastomosis groups required a tracheostomy during management. Conclusion. Congenital tracheal stenosis is a challenging problem for the airway surgeon. However, improvements in operative techniques and perioperative management have led to significant decreases in morbidity and mortality.

Introduction

Historically, long-segment congenital tracheal stenosis (CTS) held a poor prognosis with reported mortality rates as high as 57% - 79%. However, over the past several decades improvements in surgical techniques and perioperative care have dramatically improved outcomes. Multiple surgical techniques have been utilized for tracheal stenosis, including end-to-end anastomosis, costochondral graft, resection with end-to-end anastomosis, allograft, and slide tracheoplasty. However, there is no "best technique" consensus and surgeons have reported satisfactory results using a variety of techniques. In this case series, three different tracheoplasty techniques were used over the time period studied: costochondral graft, resection with end-to-end anastomosis, and slide tracheoplasty. Intraoperative airway options include intubation with placement of auffed endotracheal tube distal to the stenotic segment, split endotracheal tube with one side in each mainstem bronchus, selective intubation, bilateral jet ventilation, and cardiopulmonary bypass (CPB).

Methods

All patients underwent reconstruction utilizing one of three techniques: resection with end-to-end anastomosis, costochondral graft, or slide tracheoplasty. CPB was used for airway management in all cases. The average time on CPB was 120 minutes for slide tracheoplasty, 60 minutes for end-to-end anastomosis, and 64 minutes for costochondral graft. There was an superficial stenotomy wound infection that resolved with opening the incision and antibiotics. Eight patients (72.7%) had cardiac anomalies, 7 of which required surgical repair. Of the 7 that required repair, only 3 underwent simultaneous repair. There were no perioperative deaths and one late death (9%) from presumed respiratory obstruction; however, there was no obstruction seen with bedside bronchoscopy during the resuscitation effort and no residual stenosis seen at the post mortem. Three patients (27%) required a tracheostomy. Of these patients, one died, one was decannulated but continued to require frequent dilatation, and one was not decannulated at the last follow up.

Discussion

Chiu and Kim reported the operative mortality of patients younger than one month to be 78% versus 19% for patients older than one month, and 53% for patients with intracardiac anomalies versus 18% for those without. This was true in our series, with the one death occurring in a very young and compromised patient. Because of this increased risk in very young patients, reconstructive surgery should be delayed as long as possible. Patients that underwent slide tracheoplasty or resection with end-to-end anastomosis required fewer postoperative bronchoscopies for granulation tissue or residual stenosis. If patients did well in the early post operative period they also did well in the long term.

Multiple methods of airway management during tracheal surgery have been described; however, all methods that utilize the lungs for oxygenation interfere with the surgical field in some way. This can make a technically challenging surgery even more difficult and result in a compromised repair. CPB allows excellent exposure and at an experienced center risks can be minimized. Also, in many instances, CPB is needed for simultaneous repair of associated cardiovascular anomalies.

Results

Additionally, the utility of CPB in tracheoplasty is analyzed. Furthermore, the morbidity and mortality of slides tracheoplasty for distal tracheal stenosis to costochondral graft and resection with end-to-end anastomosis are compared.

Early Patient Outcomes

Patient Type of reconstruction Operative time/bypass time (mins) Timing of cardiac repair Length of post-op intubation Perioperative complications
1 Slide 16775 N/A < 24 hrs None
2 Slide 195107 Simultaneous 48 hrs None
3 Slide 270415 N/A 4 days None
4 Resection with end-to-end anastomosis 300075 N/A < 24 hrs None
5 Slide 240155 45 days after < 24 hrs Granulation, infection of sternotomy incision
6 Costochondral graft 26808 Simultaneous 48 hrs None
7 Costochondral graft, stenotic bronchi not grafted 21894 6 months later Never exsutated Tracheobronchial obstruction secondary to granulation, tracheostomy
8 End-to-end anastomosis N/A: 45 PA was not divided 48 hrs None
9 Costochondral graft 1704 48 prior to tracheal reconstruction required tracheostomy Tracheal blending and obstruction, tracheostomy
10 Costochondral graft, bronchi not grafted N/A: 45 N/A Required tracheostomy and chronic ventilation Soft tissue stenosis at proximal graft site requiring tracheostomy and chronic ventilation
11 Costochondral graft extending into the right mainstem N/A: 45 Prior to diagnosis of tracheal stenosis 7 days Stroke in right MCA distribution, no airway complications

Late Patient Outcomes

Conclusion

CTS presents in a heterogeneous group of patients and treatment should be individualized based on symptoms. If the patient has severe symptoms or symptoms that exacerbate co-morbidities (especially cardiac) surgical repair should be undertaken. Choice of surgical technique is largely surgeon dependent; however, the authors now prefer the slide tracheoplasty technique for medium to long segment stenosis, and resection with end-to-end anastomosis for very short segment stenosis where there will be no tension on the anastomosis. Cardiopulmonary bypass provides adequate oxygenation while maintaining excellent exposure of the trachea, and therefore it is routinely used at our institution in these cases.

References