Side-to-Side Tracheobronchoplasty to Reconstruct Complex Congenital Tracheobronchial Stenosis

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Background. **Long segment tracheobronchial stenosis is a rare congenital anomaly that can also occur in combination with abnormal bronchial arborization. Long segment tracheal reconstruction in the setting of a supernumerary bridging bronchus has been reported; however, these repairs can be particularly complex. We present our experience using the bridging bronchus to augment long segment tracheal stenosis with a side-to-side tracheobronchoplasty.**

Methods. **Four patients with complex long segment tracheobronchial stenosis involving a bronchus suis (right upper lobe bronchus) and a bridging bronchus presented with refractory respiratory distress requiring urgent tracheal reconstruction. Patient 1 was initially managed with modified slide tracheoplasty and tracheostomy. Patients 2, 3, and 4 were managed with single-stage procedures. All patients underwent definitive long segment tracheobronchoplasty consisting of a side-to-side anastomosis between the bridging bronchus and the right upper lobe bronchus.**

Results. **Age at surgery was 569, 69, 24, and 142 days, respectively. Weight at surgery was 9.3, 4.3, 2.7, and 5.9 kg. All patients were weaned from mechanical ventilation at 84, 13, 47, and 8 days after side-to-side tracheobronchoplasty. All patients were alive and free from tracheostomy at follow-up of 6.7, 3.8, 2.7, and 0.5 years.**

Conclusions. **Side-to-side tracheal reconstruction is feasible in severe cases of long segment tracheal stenosis with a right upper lobe bronchus and a bridging bronchus. This technique can be successfully applied in high-risk patients and in the neonatal period and can provide excellent midterm results.**

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Congenital tracheal stenosis is a rare and potentially life-threatening anomaly that often requires invasive mechanical ventilation and definitive tracheal reconstruction. It may be present with abnormal arborization of the tracheobronchial tree, which complicates standard slide tracheoplasty techniques. Examples of abnormal tracheobronchial patterns include a bridging bronchus, which refers to an anomalous right bronchial branch which originates from the left main bronchus and "bridges" the mediastinum to aerate the right middle and lower lobes (Fig 1A). Originally described by Gonzalez-Crussi and colleagues [1] in 1976, other minor variations of this phenotype have been described as well [2]. In addition, congenital tracheal stenosis is frequently present with congenital heart disease, in particular pulmonary artery sling (PAS) [3].

Traditional surgical options for congenital tracheal stenosis include tracheal resection with end-to-end anastomosis for short-segment stenosis and slide tracheoplasty for longer segment stenosis [3]. Autologous pericardial patch tracheoplasty has also been described, but this approach does not provide a stable cartilaginous wall or normal respiratory epithelium. These techniques can be complicated to apply in cases of very long segment tracheal stenosis, which involves the carina and main bronchi, and in cases of abnormal tracheobronchial arborization. Modified slide tracheoplasty for tracheal reconstruction in these settings has been reported [4]. Hagl and colleagues [5] reported 1 case of side-to-side reconstruction using a bridging bronchus in a 4-year-old patient who remained symptomatic years after repair of PAS. We present our experience with side-to side tracheobronchoplasty using a bridging bronchus to augment native tracheal diameter in 4 patients, including 1 neonate, the most recent 3 of whom were managed with a single-stage procedure. By anastomosing the right upper lobe bronchus to the proximal left main bronchus and the bronchus bridging bronchus in a side-to-side fashion, the luminal diameter is significantly

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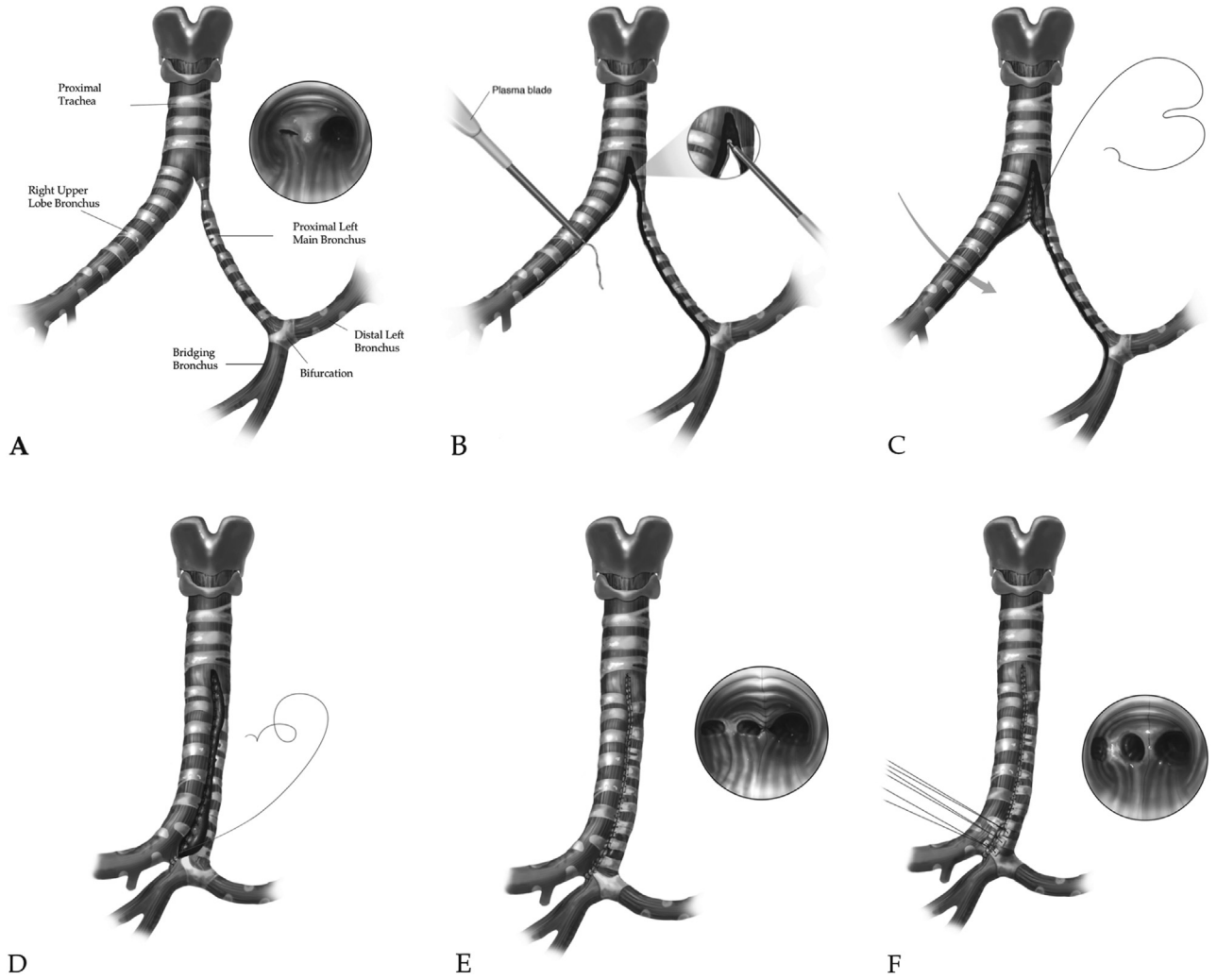

Fig 1. Technique of side-to-side tracheobronchoplasty. (A) Preoperative anatomy and bronchoscopy. (B) Incision is begun from the right wall of the bridging bronchus, carried up through the proximal left main bronchus, and down the left wall of the right upper lobe bronchus. A strip of tissue is removed to avoid a narrowing of the anastomosis in this critical region. (C) Anastomosis is performed using a running absorbable monofilament suture. (D) Anastomosis is continued onto the anterior aspect of the right upper lobe bronchus, proximal left main bronchus, and bridging bronchus, forming the neotrachea. (E) Completed tracheal reconstruction with bronchoscopy demonstrating trifurcated carina and some distal malacia. If residual tracheomalacia is present, anterior tracheal suspension can be performed (F) under direct bronchoscopic vision to ensure optimal luminal enlargement without distortion.

augmented without shortening the trachea, placing tension on the anastomosis, or significantly distorting native anatomy. We have found this to be a simple and potentially robust solution to a difficult problem in this small series of high-risk patients.

Patients and Methods

Institutional Review Board approval was granted and requirement of informed consent was waived for this retrospective review. Perioperative data included gender, age and weight at surgery, and preoperative bronchoscopic findings. Operative and postoperative data included cardiopulmonary bypass time, time to liberation from tracheostomy or mechanical ventilation, length of stay, perioperative complications, scheduled respiratory medications, and functional status at most recent follow-up.

Technique of Side-to-Side Tracheobronchoplasty

The patient is placed supine on the operating room table and general anesthesia is induced. Transesophageal echocardiogram is placed to define cardiac anatomy, particularly to rule out the presence of anomalous venous return or atrial septal defect (ASD). Bronchoscopy is then performed to define the degree of tracheal stenosis, and in some cases define the tracheobronchial anatomy, although often the degree of stenosis prohibits this.

The patient is prepped and draped and a full median sternotomy is performed. Cardiopulmonary bypass is initiated and a patent ductus arteriosis (PDA) is ligated if