External Fixation of Proximal Tracheal Airway Stents: A Modified Technique

Adnan Majid, MD, Sebastian Fernandez-Bussy, MD, Michael Kent, MD, Erik Folch, MD, MS, Liliana Fernandez, MD, FCCP, George Cheng, MD, PhD, and Sidhu P. Gangadharan, MD, FCCP

Division of Thoracic Surgery and Interventional Pulmonology, Beth Israel Deaconess Medical Center, Boston, Massachusetts; Division of Pulmonary Medicine, Clinica Alemana–Universidad del Desarrollo, Santiago, Chile; Division of Pulmonary Medicine, Fundacion Clinica Valle del Lili–ICESI, Cali, Colombia

Treatment of subglottic and proximal tracheal stenosis for nonsurgical candidates includes tracheostomy, Montgomery T tubes, and silicone stents. When used in lesions with concomitant malacia, silicone stents have a high incidence of migration. We describe a simple and effective technique of securing endoluminal stents using an Endo Close suturing device (Coviden, Boston, MA) and an external silicone button in 9 consecutive patients.

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Proximal tracheal stenosis is a life-threatening condition most commonly encountered after orotracheal intubation or tracheostomy [1]. Airway stenosis is classified into two groups: simple and complex. Simple stenosis is defined by lesions smaller than 1 cm and includes granulomas, web-like, and concentric scars. Complex stenosis includes lesions greater than 1 cm, an A-shape fracture of the cartilaginous airway, or stenosis with concomitant malacia [2].

The management of this disease is not standardized worldwide [3]. An endoscopic approach is generally considered appropriate for simple stenosis, but only as a bridge to surgical reconstruction for complex lesions. Traditionally, long-term treatment options for patients with complex tracheal stenosis who are not deemed to be surgical candidates include tracheotomy, Montgomery T tubes, or silicone stents. This report describes a modified technique that involves external fixation of a stent using an Endo Close suturing device (Coviden, Boston, MA) and the results when used in 9 consecutive patients.

Technique

After Institutional Review Board approval at Beth Israel Deaconess Medical Center, we conducted a retrospective review of medical records of patients undergoing rigid bronchoscopy and stent placement with external fixation from February 2007 to August 2010. Records were reviewed, and age, sex, comorbidities, presenting symptoms, indications, characteristics of airway lesion (location, length, type), type of stent used, signs and symptoms after the intervention, complications, and time to follow-up were recorded.

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Address correspondence to Dr Majid, Chest Disease Center, Beth Israel Deaconess Medical Center, Harvard Medical School, 185 Pilgrim Rd, Deaconess-201, Boston, MA 02215; e-mail: amajid@bidmc.harvard.edu.

Procedure

All procedures were performed in the operating room under total intravenous anesthesia. Patients were intubated with a rigid tracheoscope (Bryan Dumon, Woburn MA) and ventilated using the Monsoon Deluxe Jet Ventilator (Acutronic, Hirzel, Switzerland). After the initial endoscopic intervention, comprising balloon dilatation, radial incisions with an electrocautery knife, and microdebridement or argon plasma coagulation, a Novatech Dumon TD Tracheal silicone stent (Boston Medical Products, Westborough, MA) was loaded into a dedicated stent loader (Bryan Corp, Woburn, MA). The diameter of the stent used was determined by measuring the anteroposterior and lateral diameters at the level of the cricoid, proximal, and midtrachea using the axial and coronal images of the preprocedural airway computed tomography scans. The length of the stent was determined intraoperatively, after measuring the length of the airway lesion.

The rigid tracheoscope was positioned 1 cm proximal to the area of maximal obstruction, and the stent was deployed into the airway. The patient's neck was extended, and the cricoid and the first and second tracheal rings were identified. The skin was prepared with chlorhexidine, draped in the usual fashion, and 5 mL of lidocaine 1.5% with epinephrine were injected at the entry site.

Under direct bronchoscopic guidance, a 16-gauge intravenous catheter was introduced anteriorly between the second and third tracheal rings through the airway and the stent (Fig 1A; Fig 2A). The needle was removed, and a 0-0 silk suture was introduced through the catheter into the airway (Fig 2B). A rigid forceps was used to grasp the silk and pull it out from the rigid barrel (Fig 2C).

The Endo Close suturing device was then introduced into the airway and through the stent 1 cm proximally to the suture, between the first and second tracheal rings

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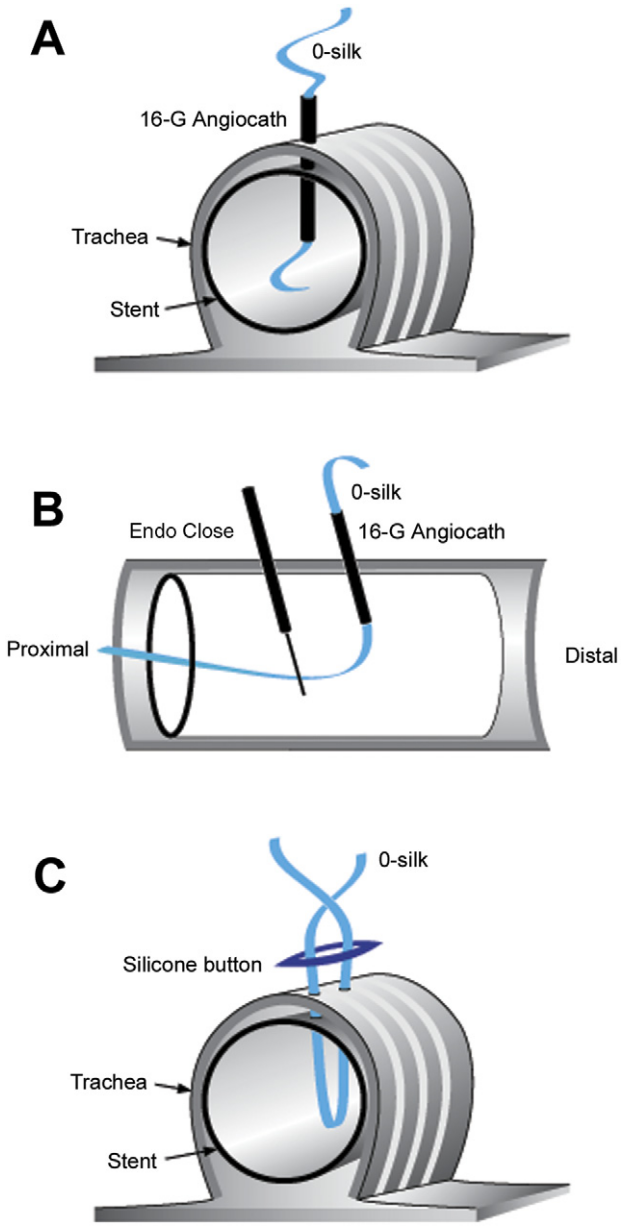

Fig 1. (A) An intravenous catheter is introduced into the trachea through the sten. (B) A 0-0 silk suture is introduced into the airway, and the Endo Close suturing device is introduced into the airway through the stent, 1 cm proximal to the angiographic catheter (between the first and second tracheal ring). (C) The ends of the suture are introduced into the silicone button and secured by a knot.

anteriorly (Fig 1B; Fig 2D). The suturing device has a spring-loaded blunt stylet mechanism. The stylet retracts as the needle is pushed through the tracheal wall and automatically advances once the airway wall has been penetrated. The stylet has a notched end that is used to capture and hold suture. Once the suture is captured, it is pulled out from the airway. The two ends of the suture were introduced through a silicone button using the suturing device and tied down (Fig 1C; Fig 2E). A curved Kelly forceps was introduced underneath the button, before the knot was secured, to avoid excessive pressure on the skin (Fig 2F).

Postoperatively, all patients underwent flexible bronchoscopy at 24 to 48 hours, at 4 weeks, and every 12 weeks if needed, according to our protocol. All patients were prescribed oral guaifenesin (1,200 mg twice daily) and some were given nebulized 20% *N*-acetylcysteine and albuterol twice daily to prevent mucus plugging.

Results

The study included 9 patients (4 women and 5 men) with a mean age of 72.6 years (range, 61 to 88 years). Comorbid conditions included coronary artery disease in 7, hypertension in 6, hyperlipidemia in 6; congestive heart failure, chronic obstructive lung disease, and gastroesophageal reflux disease in 5 patients each; obesity in 4, diabetes mellitus in 4, chronic renal failure in 3, cerebrovascular accident in 2, sleep apnea in 2, and esophageal cancer complicated with tracheoesophageal fistula in 1. The presenting symptoms were severe dyspnea at rest in 8, stridor in 6, and cough in 9. The indications for intervention included stenosis after intubation in 2 and after tracheotomy in 4, failed tracheal operation in 2, and a tracheoesophageal fistula in 1.

All lesions were complex, with a mean length of 20 mm (range, 10 to 40 mm) and a mean airway lumen of 7 mm (range, 4 to 8 mm). Four lesions had associated severe diffuse or segmental tracheomalacia. All lesions were located in the proximal trachea. The type of stents used included 8 Novatech Dumon TD Tracheal Stents and 1 metallic Ultraflex covered stent (Boston Scientific Corp, Natick, MA).

After the intervention, all patients reported improvement in dyspnea and resolution of stridor. Cough significantly improved in 7 patients and completely resolved in 2. Stent-related complications included mucus plugging in 2 patients, stent migration after endotracheal intubation in 1, and granulation tissue formation in 2. Complications related to external fixation included, in 1 patient each, cellulitis, suture breakdown, granulation tissue, and subcutaneous embedding of the external silicone button. These complications were all easily treated or had no long-term consequences. Patients were monitored for a mean of 11.2 months (range, 1 to 29 months) after intervention, and no instances of spontaneous stent migration were reported.

Comment

We describe a simple and effective technique of securing endoluminal stents deployed in the proximal trachea and report the results in 9 consecutive patients. We also describe a low incidence of reversible complications. Our cohort included patients with multiple cardiovascular, pulmonary, and systemic comorbidities that precluded them from undergoing a surgical intervention.

Silicone stents are an attractive therapeutic option because they preserve laryngeal function and do not require the presence of a stoma. Unfortunately, patients with airway stenosis, and especially those with concomitant malacia, have a high incidence of stent failure due to

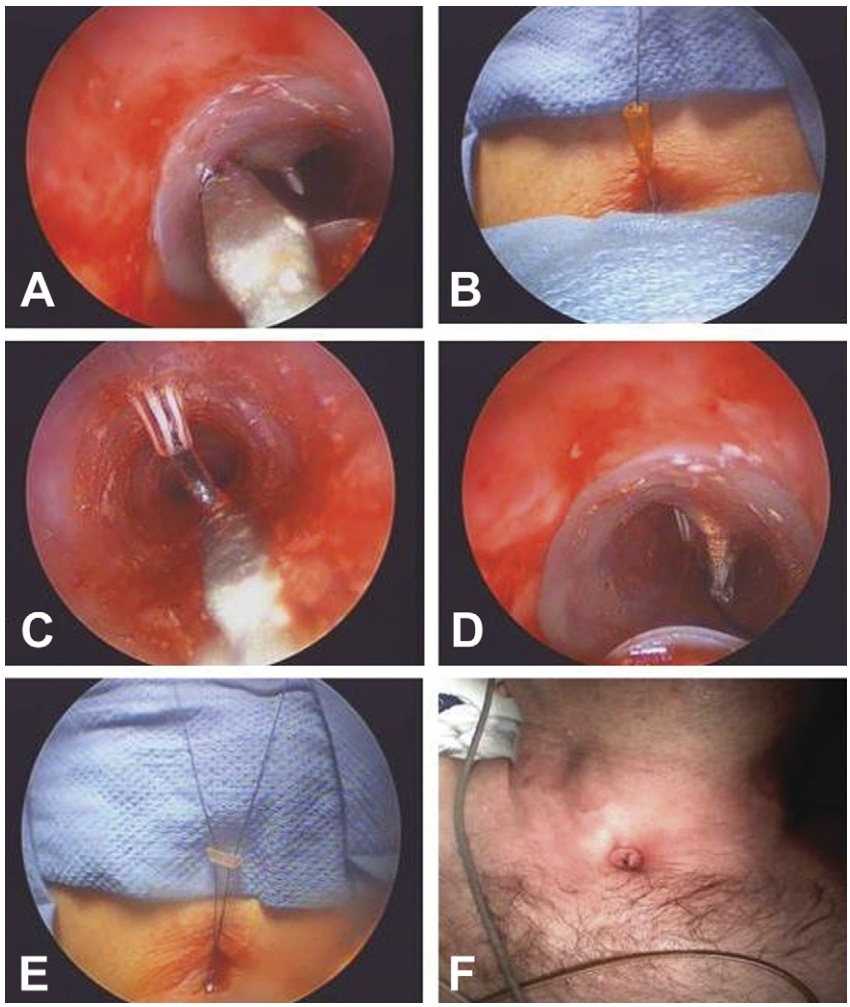

Fig 2. (A) Under direct bronchoscopic guidance, a 16-gauge angiographic catheter was introduced between the second and third tracheal ring at 12 o'clock. (B) The needle was retracted, and a 0-0 silk suture was introduced through the catheter into the airway. (C) The silk was grasped with a rigid forceps and pulled proximal and out from the rigid barrel. (D) The Endo Close suture device was introduced into the airway 1 cm proximal between the first and second tracheal ring at 12 o'clock. (E) The two ends of the suture were introduced through a silicone button and secure by a knot. (F) The external silicone button has been sutured in place.

migration, up to 18% [4]. Several authors have described techniques to externally fix a silicone stent deployed in the subglottic or proximal trachea. Unfortunately, these techniques are cumbersome, difficult, and have not gained popularity [5–8]. Our series also includes a metallic stent that was externally secured after initial migration using this method.

In experienced hands, silicone and metallic stents placed in the proximal airway can be secured successfully using an Endo Close suturing device and an external silicone button. This technique should be considered as an alternative for patients who are not candidates for tracheal resection and reconstruction.

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