Bronchoscopic Treatment in the Management of Benign Tracheal Stenosis: Choices for Simple and Complex Tracheal Stenosis

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Background. **Bronchoscopic treatment is 1 of the treatment choices for both palliative and definitive treatment of benign tracheal stenosis. There is no consensus on the management of these patients, however, especially patients having complex stenoses. The aim of the present study was to assess, in the largest group of patients with complex stenoses yet reported, which types of tracheal stenosis are amenable to optimal management by bronchoscopic treatment.**

Methods. **The present study was a retrospective cohort study including 132 consecutive patients with benign tracheal stenoses diagnosed between August 2005 and January 2013. The mean age of the study population was 52 ± 18 years; 62 (47%) were women and 70 (53%) were men. Their lesions were classified as simple and complex stenoses.**

Results. **Simple stenoses (n = 6) were treated with 12 rigid and flexible bronchoscopic procedures (mean of 2 per patient); 5 stents were placed. The total success rate was 100%. Among the 124 complex stenoses, 4 were treated directly with surgical intervention. In total, 481 rigid and 487 flexible bronchoscopic procedures were performed in these patients. In this group, the success rate was 69.8%.**

Conclusions. **From the present study, we propose that after accurate classification, interventional bronchoscopic management may have an important role in the treatment of benign tracheal stenosis. Bronchoscopic treatment should be considered as first-line therapy for simple stenoses, whereas complex stenoses need a multidisciplinary approach and often require surgical intervention. However, bronchoscopic treatment may be a valid conservative approach in the management of patients with complex tracheal stenosis who are not eligible for operative treatment.**

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The most common causes of acquired benign tracheal stenosis are endotracheal intubation and tracheostomy [1]. Tracheal stenosis caused by tracheal intubation or tracheostomy, or both, is a surgical problem that can also be managed by nonoperative techniques, including interventional bronchoscopic dilation, endoluminal treatment with lasers, and stenting [2–8]. Tracheal sleeve resection is the first and definitive treatment, particularly for complex tracheal stenosis [7]. However, bronchoscopic management has been reported to have a good success rate in selected patients [5, 6]. In complex lesions, operative treatment has been considered the first option [2, 7]. Although it has been proposed that bronchoscopic management of tracheal stenosis is an alternative to operation only in those selected cases not eligible for a surgical approach, endoluminal treatment can have an important role in the management of both simple and selected complex tracheal stenosis cases. There is no definitive or proven consensus about the endoluminal treatment of complex tracheal stenosis.

The aim of the present study was to contribute a previously defined as correct therapeutic algorithm for the management of patients with benign tracheal stenoses, especially complex benign tracheal stenoses, in a large series of patients.

Material and Methods

Clinical Definitions

Tracheal stenoses with extensive scarring (≥1 cm) and varying degrees of cartilage involvement or circumferential contraction scarring or tracheal stenoses associated with malacia and inflammation were defined as complex; simple stenoses were defined as lesions having endoluminal occlusion of a short segment (<1 cm), with the absence of tracheomalacia or loss of cartilaginous support [7, 8]. A thoracic computed tomographic scan was used as a noninvasive method of evaluation to identify all degrees of tracheal stenosis in all nonemergency cases

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preoperatively and during follow-up. A bronchoscopic view was used to identify all degrees of tracheal stenosis in all the patients in the study population [9, 10]. Patients were considered "cured" when there was no recurrence after 1 year from the last interventional procedure [2]. According to the American Society of Anesthesiologists classification for preoperative evaluations, advanced renal, cardiac, pulmonary, neuromuscular, or hepatic dysfunction was used as an inoperability criterion for the present patients [11, 12].

Study Population and Study Design

The present study was designed as a retrospective cohort study including 132 consecutive patients with benign tracheal stenosis who were diagnosed between August 2005 and January 2013. Our tertiary center is a referral center especially for complex benign tracheal stenosis. All the patients had a history of intubation or tracheostomy, or both. The mean age of the study population was 52 ± 18 years; 62 (47%) of them were women.

Bronchoscopic Techniques

First, diagnostic flexible bronchoscopy was performed to define the type, localization, and severity of the stenosis in most patients (n = 91). All patients were then intubated with a rigid bronchoscope (Efer Endoscopy, La Ciotat, France) under general anesthesia using standardized intravenous techniques. Argon plasma coagulation (40 W, blended mode/continuous flow) was applied using an instrument manufactured by ERBE Elektromedizin GmbH, (Tübingen, Germany). A diode laser operating at a wavelength of 980 nm with 4 to 25 W in pulsed mode (Biolitec Ceralas D25; Biolitec, Jena, Germany) was used for the endoluminal treatment. Cryotherapy was performed using the ERBOKRYO system (Elektromedizin GmbH, Tubingen, Germany). The stenotic area was dilated with a rigid bronchoscope. Dumon stents (Novatech, La Ciotat, France) were inserted using appropriate equipment, as described by Dumon [13]. All the patients were followed with fiberoptic bronchoscopy at 1, 3, 6, 9, 12, 18, and 24 months after the initial treatment. In cases of recurrent stenosis, the patients were reevaluated for a potential surgical approach. In case of contraindications, additional bronchoscopic treatments were performed until new stent placement.

Mitomycin Application

The stenotic region was treated with topical mitomycin C after the endoluminal treatment. Small pieces of gauze were wetted with mitomycin C (0.2 mg/mL) and applied to the stenotic region radially using rigid forceps. The total time that the stenotic region was exposed to topical mitomycin C was about 10 minutes.

Results

Patient Characteristics and Follow-Up

Of the 132 patients treated for benign tracheal stenosis from August 2005 to January 2013, all were included in the study. Table 1 shows the clinical characteristics of the patients. Respiratory causes were the most common underlying medical condition for initial respiratory failure in the current population. Trauma was the most common surgical reason for respiratory failure. The most common symptom was dyspnea. Only 2 patients of those with tracheal stenosis were asymptomatic . They were referred by their primary physicians after a history of difficult weaning, and their stenoses were visualized by computed tomography followed by bronchoscopy. We decided not to defer the endoscopic treatment based on the computed tomographic and bronchoscopic findings. Most patients (n = 122) had a history of intubation, and 42 patients had a history of tracheostomy. The mean duration of follow-up was 1.2 ± 0.08 years for patients having simple stenoses and 1.6 ± 1.45 years for patients having complex stenoses.

Bronchoscopic Findings, Type and Localization of the Tracheal Stenosis, and Treatment Choice

The total numbers of rigid and flexible bronchoscopic procedures were 495 and 501, respectively. In total, 124 complex and 6 simple stenoses were included in this

Table 1. Clinical Characteristics of the Study Population[a]

Age (y)	52 ± 18
Male to female ratio	70:62
Underlying diseases and comorbidities	
Respiratory failure	120
Coronary heart diseases	9
Congestive heart failure	18
Diabetes mellitus	22
Chronic obstructive pulmonary disease	28
Asthma	3
Hypertension	31
Obstructive sleep apnea syndrome	4
Cause of initial respiratory insufficiency	
Medical causes	88
Respiratory	46
Cardiac	22
Neurologic	20
Surgical causes	32
Trauma	22
Postoperative	10
Patients without respiratory failure	12
Major presenting symptoms and signs	
Dyspnea	99
Wheezing	35
Cough	22
Sputum production	16
Stridor	2
Asymptomatic	2
Previous intubation history	122
Previous tracheostomy history	42

[a] Data are expressed as mean ± standard deviation or number of patients.