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Staged dilation and stenting for long segmental tracheobronchial stenosis caused by tuberculosis

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Endobronchial tuberculosis is defined as tuberculosis of the tracheobronchial tree (TTBT) with microbiological evidence. The estimated prevalence of this complication in patients with pulmonary tuberculosis is 10% to 40%, and more than 90% of patients with endobronchial tuberculosis have some degree of bronchial stenosis.¹ TTBT, in general, is known for its propensity for longer segmental involvement. Despite adequate antituberculosis therapy, tracheobronchial stenosis may develop.² Although several therapeutic approaches, including antituberculous chemotherapy combined with steroids, balloon dilation, laser photoresection, and surgical resection, have been attempted in these patients, the results are largely unsatisfactory.^{1,2} Long-segment tracheobronchial stenosis (LTBS) provides a complex challenge to stenting,³ but staged stenting can offer an attractive alternative to standard LTBS therapy.

We report a method of staged stenting used to periodically dilate the stenotic area, and this method is contrary to accepted recommendations for the insertion of single stent or double stents. Because the site is problematic to manage and reobstruction of the airway is likely, repeated dilation and stenting is an appealing option.

Clinical Summary

From February 2001 through May 2002, 3 patients (ages 28, 44, and 62 years; 2 women and 1 man) with tuberculosis had severe airway obstruction and were treated at our institution. The diagnosis of LTBS was considered if chest radiograph or sputum culture was positive for tuberculosis and bronchoscopy and computed tomography (CT) revealed stenosis of the airway. Following failure of 6 months of medical therapy to relieve stenosis, surgical intervention was performed to relieve the compromised airway after the sputum cultures became negative for tuberculous bacilli. A midline tracheostomy was performed first. After 1 to 2 weeks all patients fasted for 8 hours before airway stenting preparation. The Bakes common bile duct dilators (Pro-Med, Instrumente GmbH, Tuttlingen, Germany) were employed for progressive dilation under a flexible guided bronchoscope through the tracheostoma; anesthesia was continued through the oral endotracheal tube simultaneously (Figure 1). The stenotic lengths were as follows: (1) 1 cm in the trachea portion and 2 cm in the left main bronchus; (2) 2 cm in the trachea portion and 3 cm in the left main bronchus; and (3) 4 cm in the left bronchus by bronchoscopic examination during the operation. A measured length of silicone endotracheal tube or chest tube was used to bypass the stenotic area as the connecting conduits to the stoma portion of conventional tracheostomy tube, which we labeled the "tracheostomy stent" (Figure 2).

Because the tracheostomy stent was easily removed and repeatedly inserted, the patients could receive repeated dilation by employing a temporary tracheostomy stent via tracheostoma and flexible bronchoscopy until the stenotic lumen become larger. Fiberoptic bronchoscopy was performed every month until there was no subsequent change in the endobronchial lesions, and then the dynamic Y stents (Willy Rusch AG, Kernen, Germany) were implanted in the individual patients 1, 2, and 8 months later, respectively. During this period, the respective numbers of repeated dilations were 2, 1, and 3.

In recent follow-up study, the first patient had minimal whitish sputum, and no granulation tissue was found in the last bronchos-

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Figure 1. Schematic drawing of progressive dilation through the tracheostoma with Bakes common bile duct dilators and flexible bronchoscope.

copy, 18 months after the insertion of dynamic Y stent. The postoperative bronchial size was about 11 to 13 mm, and the patient felt comfortable about the implantation of dynamic Y stent and did not want the dynamic Y stent to be removed. The dynamic Y stent of the second patient was removed 6 months after insertion, but proximal tracheal granulation tissue and stenosis were examined 4 months after removal of dynamic Y stent. A T tube with outer diameter of 13 mm was inserted recently. In the third patient, the dynamic Y stent was unpredictably slipped out during the routine examination with a flexible bronchoscopy after 2 months, but the lumen was enlarged during follow-up bronchoscopic examination 1 month after removal.

Discussion

Tuberculous LTBS is an unusual but not rare abnormality. It is recommended that patients with pulmonary tuberculosis and radiographic evidence of volume loss undergo bronchoscopy to rule out tuberculous LTBS. It is difficult to evaluate the degree of

bronchial stenosis in these patients by chest radiography, which only shows secondary changes of the lung parenchyma and enlarged lymph nodes. Chest CT, however, is useful in identifying bronchial stenosis caused by tuberculosis.⁴

Effective drug therapy has changed the prognosis of pulmonary tuberculous disease substantially, but significant stenosis of tracheobronchial involvement can still develop.³ Review of the literature revealed that no method to date has proved an ideal treatment for this complication. Although balloon dilation is less invasive, restenosis of the dilated bronchus occurs frequently. This study demonstrates the value of staged repeated stenting for management of long segmental airway obstruction. The tracheostomy stent has been designed for this purpose and is considered a bridge stent for this patient group until a suitably sized dynamic Y stent becomes available. The disadvantages of the metallic stents include the inability to remove the stents, granuloma formation, stent migration, fatal massive hemoptysis, rupture of the metallic mesh, obstruction, and wall perforation. Expandable metallic stents do

Figure 2. A measured length of tracheostomy stent was used to bypass the stenotic areas.

not appear to be a safe and long-term treatment for endobronchial tuberculosis.^{5,6} Our strategy requires the development of a stent device for progressive bouginage and curettage. Design goals include respiratory support, 3-month tracheostomy stent durability, and the potential to implant a dynamic Y stent without a necessary tracheostoma. Tracheostomy stents evolved as a treatment option in respiratory failure, providing support while offering time for diseased airways to recover and stabilize. When a tracheostomy stent is used longer than 3 months, it becomes less complicated and more cost-effective, making it a convenient treatment for prolonged support. A dynamic Y stent device, capable of providing permanency to patients, could support both acute and chronic airway stenotic patients. Fundamental to the success of this strategy is the ability to use regular mucolytic agents for extended periods.

The concept of staged stenting is new, and this approach through the tracheostoma may be worthy of further investigation, especially in conditions involving a deteriorated airway. At the most recent follow-up examination, no local stenosis had occurred. Thus, staged stenting is an excellent selection for severe long segmental stenosis and has a low complication rate. Its efficacy was immediate and durable.

In summary, tuberculous LTBS is locally aggressive and difficult to treat with a single stent. Repeated dilation and stenting offers the best chance for clinical improvement. Utilization of staged stenting appears especially suited for fragile patients when medical therapy fails.

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