Long-term outcome of nitinol stenting to treat asphyxia caused by postpneumonectomy syndrome

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Abstract
The long-term outcome of nitinol stents introduced into a patient with postpneumonectomy syndrome is described. Postpneumonectomy syndrome is a rare but crucial complication after pneumonectomy characterized by severe dyspnoea and recurrent airway infection caused by compression of the main bronchus. Surgical correction of mediastinal displacement and endobronchial stent placement are two major treatments for this complication; however, endobronchial stenting may be limited to those who are not suitable for operative procedures because long-term management is difficult in terms of controlling airway infections. A patient in whom we introduced double nitinol stents was successfully rescued from an emergent situation; unfortunately, he ultimately succumbed to recurrent pneumonia due to Pseudomonas aeruginosa 12 years after stent insertion.

Introduction
Pneumonectomy is one of the most radical operations for lung cancer, and its morbidity has been improving as surgical techniques evolve. Postpneumonectomy syndrome, in which bronchial compression causes dyspnoea or pneumonia, is a relatively rare but critical complication of pneumonectomy with a reported incidence of 11% in all pneumonectomy cases [1]. To manage postpneumonectomy syndrome, two major methods have developed: surgical correction with relocation of intrathoracic organs by tissue expander, and endobronchial stenting. We herein describe a patient successfully treated with endobronchial stents, who survived for a subsequent period of 12 years.

Case Report
A 60-year-old male with a diagnosis of squamous cell carcinoma in the right main bronchus underwent right pneumonectomy. Two weeks after the operation, the patient developed acute empyema due to bronchopleural fistula at the right main bronchial stump which required two additional operations within 3 months of the initial pneumonectomy. He was finally fit for discharge in reasonable condition. His rib cage developed a degree of deformity, which was not extreme because we were able to avoid thoracoplasty to achieve complete repair.

He had the first attack of “asphyxia at the table” (severe breathlessness associated with eating) a year later and was admitted to our hospital. He presented with a massive dyspnoea and cyanosis, which disappeared gradually and spontaneously as oxygen was administered. Computed tomography (CT) images and bronchoscopy showed compression of the membranous portion of the left main bronchus (Fig. 1). At that time, we did not take any interventional measures but advised the patient to avoid taking solid foods. However in the following 2 years, he had three episodes of emergency admission due to the same problem, and the symptoms became worse on each occasion. At the last admission, he had a cardiac arrest shortly after admission and underwent cardiopulmonary resuscitation followed by mechanical ventilation. We decided to introduce tracheobronchial nitinol stents under percutaneous cardiopulmonary support instead of performing surgical correction of mediastinal shift considering his history of surgical interventions.

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The patient’s trachea was distorted towards the right side and the left main bronchus curved sharply from the trachea, then ran horizontally to the left hilum. Because the strength of single stents might not be sufficient to sustain the bronchial lumen at that carinal portion, we used two nitinol stents (Covered Ultraflex™, φ 14 mm, length 8 cm and φ 16 mm, length 8 cm, Boston Scientific Corporation, Massachusetts, USA) that were placed partially overlapped for a length of 3 cm (Fig. 2).

After the successful deployment of two nitinol stents, the patient was discharged from hospital. In the following 3 years, he had three admissions due to pneumonia. A common cause of pneumonia in each admission was proven as *Pseudomonas aeruginosa* from his sputum samples that had resistance to some antibiotics.

After those admissions, he had a stable period for more than 5 years without hospitalization, though home oxygen therapy was required. But ultimately, he had another phase of recurrent pneumonia and died of chronic respiratory failure 12 years after placement of the nitinol stents. No cancer relapse was demonstrated.

**Discussion**

Postpneumonectomy syndrome is a rare but critical complication of pneumonectomy [2]. It presents with severe dyspnoea or recurrent pneumonia caused by the airway stricture. As the mediastinal displacement progresses after pneumonectomy, the trachea is retracted largely towards the emptied thoracic cavity with the resulting compression of the membranous portion of the main bronchus in the fixed space formed by the vertebral column, aortic arch, and great vessels [3]. Right pneumonectomy is more likely to cause postpneumonectomy syndrome than left pneumonectomy because the left main bronchus has a greater bifurcating angle against the vertical axis. Morbidity of postpneumonectomy syndrome has been reported in 11% of patients who underwent pneumonectomy [1]. As a variant of postpneumonectomy syndrome, asphyxia during food intake in a patient who...
underwent right pneumonectomy was previously reported [3]. It is suggested that dilatation of oesophagus by solid food intake compresses the left main bronchus as it intersects in front of the vertebral column.

Nowadays, two major fixation techniques for this complication are being practiced: mediastinal repositioning with the insertion of an expandable prosthesis into the pleural cavity and the placement of tracheobronchial stents. However, as bronchial stenting is reportedly more difficult to manage than mediastinal repositioning [4], its application would be limited despite its advantage of low invasiveness. On the contrary, intrathoracic placement of prosthetic devices has been demonstrated to be useful though it may be highly invasive and not applicable to patients who underwent multiple thoracotomies as well as to patients with previous empyema.

The long-term effects of bronchial stenting for post-pneumonectomy syndrome are rarely reported, and knowledge of the durability of such nitinol stents and the outcome of patients’ prognosis are limited. In our case, stents used for the patient had not broken for the 12-year period; instead recurrent pneumonia caused by multidrug-resistant *P. aeruginosa* had become a major issue. It is reported that *Staphylococcus aureus* and *P. aeruginosa* are two major species found in airway stents [5], and especially for *P. aeruginosa*, strains which have multidrug resistance reportedly affect 22–60% of cases. Uncontrolled airway infection may easily cause recurrent pneumonia, and ultimately lead to severe respiratory failure. Effective measures to prevent stent infections are warranted for longer survival of the patients who have their postpneumonectomy syndrome managed with tracheobronchial stents.

**Disclosure Statements**

No conflict of interest declared.

Appropriate written informed consent was obtained for publication of this case report and accompanying images.

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