Ultraflex Airway Stent for the Treatment of Tracheobronchial Stenosis due to Lung Cancer

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Background: Tracheobronchial stenosis due to inoperable lung cancer is a challenging problem, and usually presents worrisome symptoms. We report a recent 5-month experience with interventional bronchoscopy in this group of patients, and evaluate the benefit of this palliative therapy.

Materials and Methods: From May to November 2005, 5 patients with tracheobronchial stenosis due to lung cancer received interventional bronchoscopy at China Medical University Hospital. We used OLYMPUS PSD-60 unipolar electrode endobronchial electrocautery to dissect tumor tissue which had induced trachobronchial stenosis. After debulking the endobronchial tumor, we used an Ultraflex stent (Boston Scientific; Natick, MA) to maintain airway patency.

Results: The patients comprised 5 males, with ages ranging from 42 to 70 years, and a mean age of 57.4 years; all had squamous cell carcinoma of the lung with endobronchial metastasis causing intrinsic airway obstruction. They also suffered from progressive dyspnea and received interventional bronchoscopy with electrocautery and stents (1 tracheal stent in 1 patient and 5 bronchial stents in 4 patients—1 patient received 2 bronchial stents). All symptoms immediately improved after the interventional procedure. No serious complications such as bleeding or airway perforation were noted.

Conclusions: Even for patients with a very poor prognosis at the terminal stage of lung cancer, electrocautery and a stent implant for tracheobronchial stenosis must always be considered as a worthwhile palliative therapy to provide immediate symptom relief of dyspnea. (Thorac Med 2006; 21: 247-254)

Key words: tracheobronchial stenosis, interventional bronchoscopy, electrocautery, ultraflex airway stent

Introduction

Tracheobronchial stenosis due to inoperable lung cancer is a challenging problem. It usually presents worrisome symptoms such as dyspnea, cough, and hemoptysis, and may be life-threatening. An estimated 20~30% of patients with lung cancer will develop the complication of tracheobronchial stenosis [1]. This may be either intrinsic or extrinsic to the airway. Multiple therapies are available for tracheobronchial stenosis. Airway stents, external beam radiation, and bra-
chytherapy are indicated in extrinsic conditions that produce compression of the airway. Electrocautery, laser, cryotherapy, photodynamic therapy, and argon plasma coagulation with or without stents are indicated in intrinsic obstruction [2]. The aim of this study was to evaluate the benefit of electrocautery and stent insertion in a group of patients with tracheobronchial stenosis due to inoperable terminal lung cancer. We report our preliminary experience and emphasize the benefit of electrocautery debulking of airway tumors, and of tracheobronchial stent implants.

**Materials and Methods**

**Patients**

From May to November 2005, 5 patients with tracheobronchial stenosis due to lung cancer received interventional bronchoscopy at China Medical University Hospital. There were 5 males, with ages ranging from 42 to 70 years, and a mean age of 57.4 years. The etiologies were all squamous cell carcinoma of the lung with intrinsic obstruction. In the initial diagnosis, 1 patient was found to have tracheal stenosis, 3 patients had bronchial stenosis, and 1 patient had recurrent lung cancer with airway metastasis 3 months after a right upper lobe lobectomy. All patients had symptoms of airway obstruction (stridor or dyspnea).

**Interventional bronchoscopy**

We used OLYMPUS PSD-60 unipolar electrode endobronchial electrocautery to coagulate or dissect tumor tissue which had induced tracheobronchial stenosis. We performed the procedure in the bronchoscopy room without general anesthesia or ventilator use; local anesthesia and sedative drugs were administered prior to the procedure. After debulking the airway tumor, we implanted an Ultraflex stent (Boston Scientific; Natick, MA) to maintain airway patency. Its length and diameter were determined after dissection of the endobronchial tumor which had induced airway stenosis. Stents were inserted via the nasal cavity under flexible bronchoscopic guidance.

**Results**

Details regarding patient characteristics and interventional procedures are shown in Table 1. We used endoscopic electrocautery and chose Ultraflex stent emplacement because these procedures could be performed using flexible bronchoscopy. None of our patients received general anesthesia, and the interventional bronchoscopies were all performed in the examination room, without going into the operation room.

Case 1 had suffered from progressive dyspnea for more than 2 weeks. Chest computed tomography (CT) at the local medical department revealed mediastinal lymphadenopathy with central airway obstruction (Figure 1a). The patient was then transferred to our hospital where a chest CT examination could not be performed due to progressive dyspnea in the supine position. Therefore, we arranged a bronchoscopic examination, which revealed a tracheal tumor with tracheal compression and induced upper airway obstruction (Figure 1b). We then implanted a tracheal stent to release the severe tracheal compression from his lung cancer. The pulmonary function improved after stent implantation, as can be seen in Figure 1c.

Case 2 was admitted due to progressive dyspnea for 1 month. After admission, the chest X-ray (CXR) showed a collapsed right lower lung (Figure 2a). The bronchoscope revealed a right lower lobe endobronchial tumor which had...
induced the collapse. After electrocautery and stent implantation, the CXR showed right lower lung expansion (Figure 2b). The dyspnea also improved after the stent implant.

Case 3 had a Pancoast tumor (squamous cell carcinoma) of the right upper lobe, and underwent a lobectomy 3 months before this admission. He suffered from stridor for 1 week. The bronchoscope showed a recurrent tumor at the carina with a nearly totally occluded airway, as shown in Figure 3a. His dyspnea could not be relieved immediately by traditional radiotherapy or chemotherapy. Electrocautery and a stent implant were then performed, as seen in Figures 3b and 3c. After this treatment, his dyspnea and quality of life improved immediately, and he could receive standard chemotherapy for his recurrent
Discussion

Gilfoy first used electrocautery in a tracheobronchial tree in 1932 [3]. Hopper and Jackson popularized its use, using the flexible bronchoscope, for the management of both benign and malignant endobronchial disease [4-5]. The principle of electrocautery involves the use of high-frequency electrical currents via a probe to coagulate or dissect tumor tissue. It is a simple technique, and has the ability to produce rapid palliation and immediate tumor debulking [6].

Fig. 1c. Flow-volume loop before and after stent emplacement

Fig. 2a. CXR showing right lower lung collapse

Fig. 2b. CXR showing right lower lung expansion after stent emplacement
Superficial damage was noted with electrocautery for a short duration, and damage to the cartilage occurred with a longer duration [7]. The side effects of electrocautery include hemorrhage, airway perforation, aspiration pneumonia after debulking due to pus from obstructive pneumonia, and endobronchial fire.

Brachytherapy may induce relatively late responses, and photodynamic therapy and cryotherapy may cause secondary necrosis, so these interventional bronchoscopic procedures are less attractive in patients with airway obstruction due to lung cancer. Lasers (e.g., Nd-YAG) may be another good choice. However, the cost of laser therapy is around 3-fold that of electrocautery [8], and special facilities are necessary for safe laser applications. Not every hospital can provide the facilities for laser therapy, but electrocautery, which is the so-called “poor man’s laser”, can easily become a standard treatment in almost every hospital.

Airway stents were first described by Trendelenburg and Bond in the late 1800s [9]. Montgomery introduced a silicone T-tube for patients with tracheal stenosis in 1965 [10], and Jean-Francois Dumon introduced completely endoluminal airway stents in 1990 [11]. These have become the most widely used throughout the world during the past decade, due to their being economical and more easily removed. However, silicone stents must be implanted using a rigid bronchoscope under general anesthesia, and their complications, such as stent migration and retained secretion, tend to bother patients.

In 1995, Becker investigated a self-expanding device made of nitinol, the Ultraflex stent (Boston Scientific; Natick, MA), which is more flexible and resembles the physical properties of the cartilages [12]. Nitinol is a nickel and titanium alloy and has superelasticity, so it has the ability
to undergo deformation in size and shape [13]. It also has shape memory deployment, which at cold temperatures, and at higher temperatures, such as body temperature, it regains its original shape [14]. The Ultraflex stent does not show obvious expansion under forced compression, so the risk of airway perforation is lowered. This stent can be safely and quickly emplaced with a flexible bronchoscope, without the need of fluoroscopy. The procedure reduces the radiation exposure of patients and physicians, thus, it is more cost-effective [15]. Recent reports have pointed out the significant reduction of tumor cells [16] and the lack of malignant transformation of initially nontumorous tissue after an Ultraflex stent implant [17]. Stent-related complications include halitosis, perforation of the airway walls, hemoptysis, or granuloma formation at the stent ends. The Ultraflex stent seems to lower the risk of airway perforation due to the fact that it does not change in length once expanded, and that it is flexible enough to change shape when coughing occurs [18].

We presented herein our preliminary endoscopic experience with tracheobronchial stenosis in patients with inoperable lung cancer. In this study, all patients showed improvement in symptoms and CXR imaging, and experienced immediate benefits after electrocautery and stent emplacement. The use of chemotherapy or radiotherapy may lead to a partial response of treated terminal lung cancer, but it cannot immediately relieve the symptoms of airway obstruction, and radiotherapy may cause airway mucosa edema, which progresses to airway obstruction. Hence, we concluded that interventional bronchoscopy, including electrocautery tumor dissection and airway stent implantation, is a worthy palliative treatment for terminal lung cancer with tracheobronchial stenosis.

**Conclusion**

Based on our preliminary data, we concluded that even for patients with a very poor prognosis at the terminal lung cancer stage, electrocautery and airway stent emplacement for tracheobronchial stenosis must always be considered, for its ability to provide immediate symptomatic relief of dyspnea, and its role as a worthwhile palliative therapy.

**References**

氣管介入性治療對肺癌引致支氣管氣道狹窄之治療經驗

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背景：肺癌引致的支氣管氣道狹窄若是無法開刀仍舊對醫護人員是一個富有挑戰性的難題。它會使得病人出現嚴重呼吸道阻塞的症狀，使得生活品質大大降低，本文將報告我們過去5個月內的初步治療經驗。

材料與方法：我們分析從西元2005年5月至11月在台中中國醫藥大學附設醫院接受氣管介入性治療的病人。對於病人所施以的氣管介入性治療包括先使用OLYMPUS PSD-60 電燒來切除導致支氣管氣道阻塞或是狹窄的腫瘤，之後在狹窄的部位再施以Ultraflex (Boston Scientific; Natick, MA) 氣管支架支撐。

結果：從西元2005年5月至11月，總共有5位病人接受氣管介入性的治療，5位病人皆是男性，年齡從42歲至70歲，平均年齡為57.4歲，導致支氣管氣道狹窄的原因皆是因為肺部腺癌上皮細胞癌，5位病人皆出現顯著呼吸道阻塞的症狀，5位病人中有1位接受氣管支架，而有3位接受支氣管支架，另外一位病人則接受二支支氣管支架，5位病人藉由氣管介入性治療包括電燒切除以及支架置放之後，臨床症狀明顯改善，同時在我們的病人中沒有嚴重的併發症例如氣道破裂或是無法控制出血的產生。

結論：對於由于肺癌引致的支氣管氣道狹窄，儘管病人是屬於末期，我們仍舊應該考慮施以氣管介入性治療包括電燒以及支架的置放，因為此種治療可以使得病人的症狀立即改善，使得生活品質得以提升，是一種可以讓病人得到最佳利益的療法。*(胸腔醫學 2006; 21: 247-254)*

關鍵詞：支氣管氣道狹窄，氣管介入性治療，電燒，支架