Successful Treatment of Lung Cancer by Multimodal Endobronchial Interventions

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Established Facts

- Early detection of endobronchial early-stage lung cancer leads to curative treatment using only a minimally invasive transbronchial approach. As for the treatment modality, photodynamic therapy shows excellent local control for endobronchial early-stage lung cancer if it has no extracartilaginous invasion.

Novel Insights

- A combination of ultrasonographic and bronchoscopic imaging techniques, including radial-probe EBUS, EBUS-TBNA, autofluorescence and narrow-band imaging, were useful for the accurate diagnosis of the early-stage centrally located lung cancer. The careful assessment of these imaging modalities led to the cure of the endobronchial squamous cell carcinoma occluding the left upper lobe bronchus by a minimally invasive transbronchial approach.

Key Words

Autofluorescence bronchoscopy · Bronchoscopic treatment · Endoscopic ultrasonography · Endoscopic ultrasound-guided fine-needle aspiration · Interventional pulmonology · Lung cancer treatment

Abstract

The innovation of thoracic interventions, such as endobronchial ultrasound and photodynamic ablation, has changed the interventional management of lung cancer. In this case report, we discuss the case of a successful treatment of endo-

bronchial squamous cell carcinoma occluding the left upper lobe bronchus by a minimally invasive transbronchial approach. This case was initially planned for a sleeve left upper lobectomy. The careful assessment of radiological and ultrasonographic imaging concluded that the tumor was early-stage lung cancer. Multimodal endobronchial treatment cured the lung cancer without a thoracotomy. Pulmonary function was well preserved and no recurrence was found for more than 5 years. Even in the presence of a bulky endobronchial tumor, if there is no clear evidence of extraluminal invasion by computed tomography scan, a local bronchoscopic staging of the disease is mandatory.

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Introduction

Recent progress of interventional pulmonology allows for better management of centrally located lung cancer. With the use of radial probe endobronchial ultrasound (RP-EBUS), we can estimate the depth of a tumor invasion within the layer of the airway [1]. Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) is well known as a highly sensitive method for the diagnosis of mediastinal and hilar lymph node metastasis [2]. As for the treatment modality, photodynamic therapy (PDT) shows excellent local control for endobronchial early-stage lung cancer if it has no extracartilaginous invasion [1]. In this report, we present a successfully assessed and treated case of centrally located squamous cell carcinoma occluding the left upper bronchus using a multimodal minimally invasive transbronchial approach.

Case Report

A 54-year-old male was referred to our hospital for the treatment of an endobronchial tumor located in the left upper lobe bronchus. He was completely asymptomatic and the lesion was found by chest computed tomography (CT) screening for high-risk current smokers (his smoking index was 1,400). Bronchoscopy showed the polypoid tumor which was occluding the left upper lobe bronchus (fig. 1a). Transbronchial biopsy was performed and it was diagnosed as squamous cell carcinoma. Metastasis work-up by contrasted abdominal CT and brain magnetic resonance imaging was negative for distant metastasis. The patient was initially thought to have needed a sleeve left upper lobectomy for curative treatment.

After further investigation, the lesion was localized within the left upper lobe bronchus and there were no signs of tumor invasion to the bronchial wall upon review of the thin-sliced CT images (fig. 1b). There were no signs of tumor invasion to the proximal mucosa by narrow-band imaging and autofluorescence bronchoscopy. We decided to reduce the tumor volume first by endobronchial snaring (fig. 1c), and then evaluate the depth of the tumor invasion in the bronchial wall by RP-EBUS. Snaring was successfully performed and the RP-EBUS revealed that the tumor did not invade the cartilage of the bronchus (fig. 1d). EBUS-TBNA was also performed for mediastinal as well as hilar lymph nodes (station 4R, 7, 4L and 11L). The result of EBUS-TBNA showed no lymph node metastasis. Hence, we diagnosed this as endobronchial early-stage lung cancer, which calls for PDT as a curative treatment option. We proposed both surgical resection and PDT as treatment options to the patient, who selected PDT as an initial treatment. PDT using Laserphyrin (Meiji Seika Pharma, Tokyo, Japan) was performed with a total of 210 J for the 1.4-cm² tumor lesion using a PD Laser (Panasonic, Tokyo, Japan; fig. 1e). After the treatment, the lesion was carefully followed by high-definition bronchoscopy with narrow-band imaging (fig. 2a, b), autofluorescence bronchoscopy and thin-sliced CT. There was no tumor re-

currence for more than 5 years and the respiratory function was well preserved (pretreatment: FVC 4.25 liters, FEV₁ 3.03 liters, 5 years after the treatment: FVC 3.93 liters, FEV₁ 3.01 liters) which allows the individual to maintain a high level of respiratory function.

Discussion

In recent decades, novel transbronchial diagnostic techniques and treatment modalities have been developed and applied to the management of centrally located lung cancer. Early detection of endobronchial early-stage lung cancer leads to curative treatment using only a minimally invasive transbronchial approach. For the success of treatment it is needless to say that accurate evaluation of the depth of tumor invasion, size of the tumor and lymph node metastasis is of utmost importance. In this case, a high-resolution chest CT scan helped to select the candidate for this minimally invasive treatment. A combination of ultrasonographic and bronchoscopic imaging techniques including RP-EBUS [1], EBUS-TBNA [2], autofluorescence [3] and narrow-band imaging [4] were useful for the accurate diagnosis of the early-stage centrally located lung cancer. It was reported that, due to its high sensitivity, RP-EBUS in addition to high-resolution chest CT improved the efficacy of PDT to determine the depth of the tumor invasion of the bronchus [1]. Autofluorescence bronchoscopy showed abnormal findings due to the post-treatment mucosal changes; therefore, narrow-band imaging was useful for the follow-up of the treated mucosa.

It is important to consider minimally invasive treatment for elderly patients in our aging society. Squamous cell carcinoma often arises in the central airway and this histological subtype has a high correlation with smoking [5]. Smokers are a high-risk population for chronic obstructive pulmonary disease with limited respiratory function. Therefore, when we treat lung cancer in patients with this disease, preserving lung parenchyma should be considered to maintain pulmonary function. Hence, this approach may be useful in the management of these types of lesions in the elderly or in patients with limited lung function. This did not apply in the reported case since the patient had good lung function. We made sure the patient was aware of all alternative options and the risks of the procedure, and we obtained consent prior to performing PDT. We also informed the patient about the possibility of salvage surgery in case of recurrence after PDT.

Fig. 1. **a** Bronchoscopy showed the polypoid tumor which was occluding the left upper lobe bronchus. **b** The lesion was localized within the left upper lobe bronchus and there were no signs of tumor invasion into the bronchial wall by high-resolution CT. **c** We first reduced the tumor volume by endobronchial snaring. **d, e** RP-EBUS revealed the tumor did not invade the cartilage (arrow) of the bronchus. **f** PDT using Laserphyrin was performed with a total of 210 J for a 1.4-cm² tumor lesion using a PD Laser.

Fig. 2. **a** The lesion was carefully followed by high-definition bronchoscopy. **b** Narrow-band imaging was also applied and it was useful for the follow-up of the post-PDT lesion.

Early-stage lung cancer with superficial limited mucosal involvement in the central airway can also be treated with a transbronchial approach such as high-powered laser and electrocautery techniques [6]. Laser ablation and electrocautery produce rapid tissue destruction in a single sitting and they are often used for the treatment of airway obstruction due to the tumor for palliation. An Nd:YAG (neodymium-doped yttrium aluminum garnet) laser is often used in this situation. Even if the possibility of using an Nd:YAG laser for treatment of early-stage centrally located tumors is reported in a small number of patients [7], this technique is not recommended due to the potential risk of airway perforation [6]. Electrocautery is a technique that ablates the tissue via the thermal effects of a

high-frequency electrical current. Only one previous publication reported that bronchoscopic electrocautery achieved an 80% complete remission rate for early-stage lung cancer [6]. Argon plasma coagulation is a non-contact mode electrocautery. The electrical arc which was generated between tissue and electrode via an ionized argon gas jet results in rapid superficial coagulation and necrosis [8]. These techniques can be used for early-stage lung cancer; however, the limited number of patients with intraepithelial disease treated with these transbronchial ablative techniques does not justify their role [8].

In conclusion, chest physicians and thoracic surgeons have to keep in mind the possibility of minimally invasive interventions for the management of centrally located lung cancer and the importance of using a multidirectional approach to achieve successful treatment of the tumor. Even though the indication of this management may be limited, it may be useful for selected patients with several co-morbidities. The role of the thoracic surgeon is a very important one due to the advantage of being able to perform salvage treatment following the failure of endobronchial interventions.

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