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Treatment of persistent air leak with endobronchial valves

Abstract

Persistent pulmonary air leaks are usually treated conservatively with prolonged thoracostomy tube drainage. In case this approach fails, surgical revision used to be the only option. This case report describes the successful treatment of a 66-year old patient who developped a pulmonary air leak after cardiothoracic surgery that persisted despite attempted surgical repair and talc pleurodesis. The treatment was successfully completed with endobronchial valves thereby demonstrating that treatment with endobronchial valves doesn't only represent an alternative to surgery, but that it can also be successful in case surgical intervention fails.

Key words: pulmonary air leak, endobronchial valve

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Introduction

A 66-year old man developed an air leak on the left side after minimally invasive direct coronary artery bypass surgery which was performed via anterolateral thoracotomy along the fourth intercostal space. He had a history of chronic obstructive pulmonary disease with bullous emphysema, and had a smoking history of 50 pack years. Because the air leak persisted on the sixteenth postoperative day, the patient underwent surgical revision where stapling of the lung at the suspected location of the leak was performed, followed by talc pleurodesis. Nonetheless, a significant leak was still observed on the sixth day after surgical revision. Consequently, it was decided to attempt to reduce the air leak by placing Zephyr endobronchial valves (EBV's) using rigid bronchoscopy while the patient was under general anaesthesia. First, a balloon-tipped catheter was inserted into the left upper lobe bronchus and the balloon was inflated to block the airflow. The chest drain was observed and a complete cessation of the air leak was noted. Subsequently, the balloon catheter was deflated and sequentially repositioned into the segmental bronchi of the upper lobe. However, occlusion of both of them did not result in a decrease of the air leak. A valve was therefore placed in each of the segmental bronchi (Figure 1) of the upper lobe bringing the total number of valves used to three (the patient only had two upper division segmental bronchi, besides the lingular bronchus). Approximately five minutes after the third valve was deploy-

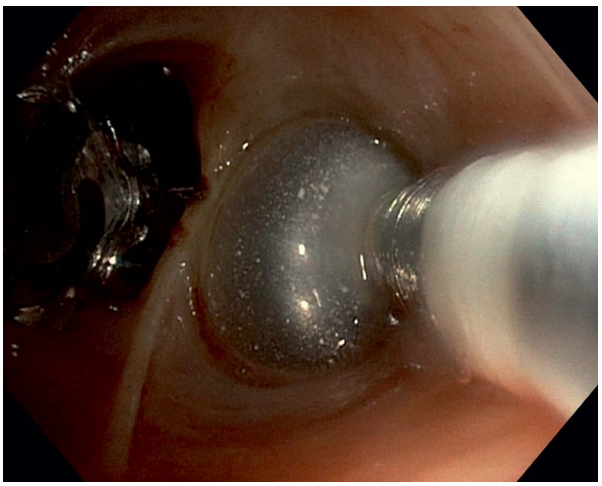

Figure 1. Endoscopic image demonstrating one valve in the medial upper lobe bronchus and the placement of a second valve in the lateral upper lobe bronchus

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ed, a decrease of the air leak to 0–10 mL/min was observed. The first day after the procedure, the patient developed respiratory insufficiency, which was quickly resolved after treatment with bronchodilators, systemic corticoisteroids and a short period of bilevel non-invasive ventilation. A chest radiograph showed elevation of the left diaphragm suggesting atelectasis of part of the left lung, but no pneumothorax. The chest tube was successfully removed on the fifth day after EBV placement and the patient was discharged home one week later with supplemental oxygen (4 L/ /min). The valves were removed 15 weeks after their placement using rigid bronchoscopy. The patient was last seen at follow-up three weeks after valve removal. His respiratory condition remained stable. His chest radiograph continued to show elevation of the left diaphragm. The patient still needed supplemental oxygen, but the flow rate was now reduced to 2 L/min.

Discussion

Pulmonary air leaks arise when there is an abnormal communication between the bronchial or alveolar spaces and the pleura through a bronchopleural or alveolar-pleural fistula [1]. A pulmonary air leak is deemed persistent when it lasts for more than 5 to 7 days postoperatively [2]. Persistent air leaks occur after 15% of thoracic procedures [3]. Of the air leaks still existing on the fourth postoperative day, 83% will still be present on the seventh postoperative day [2]. They often lead to increased morbidity resulting in prolonged hospital stays and increased healthcare costs [4].

Persistent air leaks are usually treated conservatively with prolonged thoracostomy tube drainage [1, 2, 5]. In case this approach fails, surgical revision used to be the only option. It is important to note that the patients who suffer from a persistent air leak also frequently suffer from an underlying lung disease with low FEV_1 and decreased functional status. This makes surgical intervention challenging. In addition, several other factors in this population contribute to poor wound healing such as malnutrition, diabetes, steroid use *etc.* [1]. Consequently, during the past few decades, numerous minimally invasive techniques have been developed ranging from pleurodesis with chemicals or blood components, to bronchoscopic techniques using coils, stents, antibiotics, ethanol and several other glues or adhesives [5]. However, controlled studies showing consistent efficacy are lacking.

EBVs were originally developed as a minimally invasive alternative for lung volume reduction surgery in severe emphysema [6]. EBVs are one-way valves that inhibit air-entry into a segmental bronchus, but allow for drainage of air and secretions [4]. Snell and colleagues were the first to report on the succes of EBVs for the treatment of a broncho-cutaneous fistula in 2005 [7]. Since then, several case reports and case series on the use of endobronchial valves for treatment of persistent air leaks have been published. One of the largest studies using endobronchial valves was published by Traveline and colleagues [4]. They reported a complete resolution of air leak in 47.5% of patients and a reduction of air leak in 45% of patients. In 2016, Gilbert and colleagues [8] reported data on 75 patients who recieved intrabronchial valves for a persistent air leak. Air leak resolution occured in 56% of these patients within one day or less from intrabronchial valve placement. In 37% of patients, the air leak still persisted one week after valve placement. Generally, it is recommended that the valves are removed 4 to 6 weeks after placement, but in a considerable number of cases the valves were left in place without apparent significant impairment [1, 4, 8, 9]. The number of reported adverse events is low. These include pneumonia, bacterial colonization, empyema, decrease in FEV1 and valve migration or expectoration [1, 4, 9]. Furthermore, if respiratory insufficiency occurs, the valves can be removed again.

Overall, the results indicate that endobronchial valves represent an effective treatment for persistent air leaks, especially in patients who are unfit for surgery. Furthermore, our case demonstrates that treatment with EBVs not only represents an alternative to surgery, but that it can also be succesful in case surgical intervention fails. Still, the current knowledge is largely based on case reports and retrospective case studies with a limited number of patients. Accordingly, prospective randomized controlled trials are needed.

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