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Case Report: Endobronchial Valves for Challenging Persistent Air Leaks in Bronchopleural Fistula: A Case Series

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ABSTRACT

Pneumothorax occurs when air escapes from the lungs and enters the space between the lungs and the pleural space, for which there are many reasons for this defect. There are many treatments from the past to the present that are not currently satisfactory for patients. In recent years, endobronchial valve has been used and in this study, this valve has been used for 5 patients. In all patients, a silicone valve with a size of 8-10 was used and on average, each patient had about 7 days of valving. Three out of 5 patients had underlying diseases and in the end all patients were satisfied with the type of treatment. According to the results of recent studies, it seems that a potential trial to evaluate the management of air leakage after lung resection as well as traumatic, pathological and spontaneous pneumothorax is necessary to evaluate the management of air leakage.

Introduction

Bronchopleural fistula causing persistent air leaks is one of the most serious complications after pulmonary resection such as lobectomy and pneumonectomy are associated with prolonged hospital stay, increased health-care costs and maybe morbidity (1-4). The incidence of Bronchopleural fistula post-lobectomy or pneumonectomy has been stated to be as high as 4.5%, with a related mortality of up to 27% and up to 90% of those patients require a repeat surgical procedure (4, 5). Thoracic operations, advanced pulmonary sarcoidosis, bullous emphysema, interstitial lung disease, and radiation fibrosis are the main causes of prolonged air leaks (6). Tube thoracostomy, thoracoplasty, open drainage, muscle pedicle closure and decortication are the traditional therapies for air leaks treatment. Numerous bronchoscopic

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methods to fistula closing have been used, comprising applying of tissue and fibrin glues and sealants, plugs, stents, coils, balloons, and submucosal injection of ethanol (7).

In addition to the mentioned methods, many non-surgical methods have been used, each of which has had different success rates in different patients. Prolonged chest tube settlement with either a pleural drainage system or Heimlich valve with pleurodesis via chemical, mechanical, and autologous means was the most conventional method (8, 9).

All these methods were not effectiveness. Scientists have been done huge bronchoscopic efforts to treat Bronchopleural fistula including vascular coils, tissue glue or fibrin, stents, spigots, silver nitrate, gel foam, and autologous endobronchial blood patch. But unfortunately, all these methods have its limitations and were not a suitable alternative for surgical intervention in the treatment of postresection Bronchopleural fistula (10, 11). Endobronchial one-way valves are gained approval for humanitarian use for treatment of persistent bronchopleural fistula in 2006 (12). There are some limitations on its uses and a basic and constant method cannot uses for all of the potential barriers (13). In this report, we present 5 cases of endobronchial valve users and exemplify a new, less invasive choice for the management of persistent air leak in patients with pneumothorax and resistant to treatments.

Case Presentation

Case 1

A 70-year-old man was diagnosed with complete left-sided opacification with mediastinal shift to the right with increasing in respiratory acidosis. On day 9, he was assessed for an endobronchial valve and successfully implemented in day 11. After 6 weeks, endobronchial valve was removed without any complications.

Case 2

A 32-year-old man with refractory pneumothorax due to bronchopulmonary fistula and underlying Pulmonary Langerhans cell histiocytosis. Productive cough, weight loss, fatigue, hematochezia and right middle lobe abscess (4 × 3cm) were the main clinical manifestations and admitted into the ICU for septic shock. He had experiences of obstructive cardiac arrest and need chest tube in 4 sites. On day 5, the endobronchial valve were implemented and the extubated two days later.

Case 3

A 28-year-old man with refractory pneumothorax due to bronchopulmonary fistula and concomitant pulmonary hydatid cyst disease. The patient was from the northern regions of the Iran, which is considered as an endemic of echinococcosis. The patient had no previous vascular disease and required only one point in the lung to be vuvled. The intubation was performed without any problems and the patient was monitored for up to two days and had no problems after the operation.

Case 4

A 50-year-old man with a history of kidney transplantation with refractory pneumothorax due to bronchopulmonary fistula. The patient also has a history of heart disease and diabetes and has undergone high-risk surgery. Fortunately, the intubation was successful and the patient was discharged after 3 days with complete recovery.

Case 5

A 53-year-old man with no history of underlying disease had refractory pneumothorax due to bronchopulmonary fistula. The patients had an air leak with deteriorating oxygenation, three endobronchial valves were placed in left upper lobes and the extubated after 3 weeks.

The outcomes of endobronchial valve placement for postoperative air leaks in these cases are presented in ***Table 1***.

Discussion

Tube thoracostomy, sufficient volume

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resuscitation, and serial chest radiographs are the early treatments for pneumothorax (14). Despite these treatments if still the lung did not re-expand, major airway injury should be suspected and bronchoscopy must be applied for diagnosis and then treated (15, 16).

Endobronchial valves as less invasive approaches have newly developed for the management of persistent air leak as a possible alternative to lung volume reduction surgery to treat incapacitating emphysema (1). In this report we present five cases who's used these valves to treat persistent air leak. Performing a prospective study of broncho-pulmonary fistula is difficult. But there are several reports that have defined the usefulness of Endobronchial valves in the closure of bronchopulmonary fistula.

Table 1. Outcomes of endobronchial valve placement for postoperative air leaks

Patient	Sex	Age	Number of valves	Valves use (days)	Valves size	Underlying disease
Case 1	Male	70	1	6	8-10	No
Case 2	Male	32	1	7	8-10	Pulmonary Langerhans cell histiocytosis
Case 3	Male	28	1	6	8-10	Alveolar hydatid disease
Case 4	Male	50	1	8	8-10	Kidney transplant
Case 5	Male	53	1	7	8-10	No

In 2011, Gillespie et al. the results of a series of consecutive cases that treated a complex alveolar plural fistula with an endobronchial valve were reported. The results showed that during a period of 15 months, 8 valve placement procedures were performed on 7 patients and all of them improved air leakage. The mean duration of air leakage was 4 weeks before and 1 day after treatment with an average of 4.5 days (17). In another study in 2019, Mukhtar et al. cited endobronchial valves as an innovation in the management of persistent air leaks, as an alternative to traditional therapies (pleural drainage and surgery). In their study, they examined the mortality rate, length of stay and the effectiveness of the method. In this study, 1885 patients, mostly middle-aged, male, white, and with underlying disease, who had an average of 9.8 days of valves in the lung and were introduced as a suitable and non-invasive alternative (18). In the present study, only one valve was placed for each patient, and due to the presence of underlying disease in 3 out of 5 patients, the results of CT scan showed that the amount of air leakage had stopped and the patients were completely satisfied. It was proved that removable endobronchial valves for average of 7 days are a safe and effective intervention for long-term air leakage.

Various studies have shown that endo-bronchial valves, which are used to prevent air leakage after surgery, reduce the duration of valvulation and increase the survival time of the valve (19-21). The use of this method has also increased patient satisfaction and also greatly reduced the cost of health care. In some cases, valves can be more effective in managing a cavity infection if there is sufficient airway to achieve long-term obstruction.

Conclusion

These valves can also be used to treat pulmonary air leakage in patients with pneumothorax in patients with comorbidities for whom surgery is dangerous. According to the results of recent studies, it seems that a potential trial to evaluate the management of air leakage after lung removal, as well as spontaneous traumatic, pathological and secondary pneumothorax, is necessary to evaluate the management of air leakage.

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