

## **The Use of Bronchoscopic Oxygen Insufflation to Isolate Persistent Air Leaks in Secondary Pneumothorax Due to COPD**

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**Abstract:**

The development of a persistent air-leak due to secondary pneumothorax in patients with COPD is a difficult problem. Treatment options can include surgery, pleurodesis, and various endoscopic techniques. The use of one-way valves has been reported in patients with broncho-pleural and alveolo-pleural fistulae arising after surgical resection as well as after secondary pneumothorax. Isolating the source of the leak is of paramount importance in determining where to place the one-way valves. This can be problematic in patients who only demonstrate air-leak with expiration or forced expiration. We report the use of bronchoscopic oxygen insufflation in isolating the air-leak in three patients with persistent leak only present with expiration and forced expiration.

**Keywords:** Pneumothorax, IBV valve, Oxygen Insufflation, Persistent Air-Leak

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## INTRODUCTION:

COPD constitutes a common cause of secondary spontaneous pneumothorax<sup>1,2</sup>. Up to 20% of COPD patients with spontaneous pneumothorax will develop a persistent air leak<sup>3</sup>. Treatment for persistent air-leaks can include surgery, outpatient management with Heimlich valves, and pleurodesis<sup>4</sup>. Use of blood patches has also been described<sup>5</sup>. However, many of these patients are debilitated and severely ill making surgery<sup>6</sup> and outpatient management difficult. In these patients, prolonged hospitalization due to a persistent air leak is associated with morbidity and increased costs of care<sup>6</sup>. Others will not demonstrate full expansion of the lung with chest tube drainage making pleurodesis unlikely to be successful. Endoscopic closure is also possible, and recently, one-way valves have been successfully used in persistent air-leaks secondary to surgical resections and have been studied for endoscopic lung volume reduction<sup>7,8</sup>.

We have routinely used IBV valves (Olympus Spiration, Redmond, WA) to treat persistent air-leaks from secondary pneumothorax due to COPD. The air-leak, however, can be difficult to isolate particularly in patients with intermittent air-leak only apparent on expiration, forceful expiration, or cough. Vial et al recently described the use of bronchoscopic oxygen insufflation to isolate air-leak for IBV valve placement in 2 patients with bronchopleural fistula after lung resection<sup>9</sup>. We describe three cases where bronchoscopic oxygen insufflation was successfully used to isolate air-leak due to COPD related secondary spontaneous pneumothorax.

### CASE 1:

75-year-old female with a history of severe chronic obstructive pulmonary disease was admitted with 3 days of worsening shortness of breath and right sided chest pain. She complained of mild dyspnea but was hemodynamically stable and saturating well on 2L via nasal cannula. She had been discharged one week previously from a hospitalization for COPD exacerbation. She had a CT chest 1 year ago which showed severe emphysematous changes and bullous lung disease. CXR in the ER showed a very large pneumothorax (Figure 1.). A 20Fr chest tube was placed and put to suction initially and then to water seal. On water seal, there was respiratory fluctuation in the water column and air leak only with forceful expiration

and cough. No air-leak was present with tidal breathing. On day 7, decision was made to isolate the air-leak and place IBV valves. In the OR, patient was intubated with a size 9 ET tube. Leak was successfully reproduced using a bag valve mask connected via tubing to the ET tube. However, once the bronchoscope entered the ET tube, leak could no longer be simulated likely due to increased resistance created by the bronchoscope. We then connected oxygen tubing to the bronchoscope suction port (Figure 2.). Systematically we used short 2 second bursts of oxygen insufflation into the segmental bronchi of the RML and RLL. The patient's RML was trifurcated. Leak was present with insufflation of all three segmental bronchi of the RML. A size 7 IBV valve was placed at the orifice of the RML (Figure 3). Chest tube was placed on water seal and then clamped overnight. CXR in the morning showed complete expansion of the lung and chest tube was removed (Figure 4). Patient was discharged the same day.



Figure 1. Large Right Pneumothorax

### CASE 2:

72-year-old male with a history of severe COPD was admitted with sharp right sided chest pain and dyspnea after using an electric saw to cut wood. He had a previous history of thoracoscopic bullectomy of a large left upper lobe bulla. His postoperative course was

complicated by a bronchopleural fistula and was hospitalized at a different institution for over one month until resolution. In the ED, the CXR showed large right sided pneumothorax. Initially an 8Fr chest tube was placed anteriorly in the 2nd intercostal space and placed to suction. Follow up CXRs showed incomplete expansion of the lung and a large continuous air leak. A 20Fr chest tube was then placed in the fifth intercostal space with complete expansion of the lung. The 8Fr chest tube was removed. There continued to be an air-leak with expiration only on water seal. On day 7, patient was taken to the OR for IBV valve placement. With the patient sedated and breathing comfortably, the air-leak disappeared both on suction and on water seal. As in case 1, we used sequential oxygen insufflation for 2 seconds with oxygen at 2L/min to reproduce the air leak. Leak was found to arise from RB1. Due to the extensive upper lobe bullous lung disease, decision was made to place a size 7 IBV valve at the opening of the RUL. Chest tube was left to suction for 2 hours then clamped overnight. Morning CXR showed complete expansion of the right lung. Of note, on one month follow up the patient described a significant improvement in exercise tolerance.



**Figure 3.** IBV valve placement at the orifice of the RML bronchus.

#### **CASE 3:**

79-year-old male with severe COPD was admitted to the ICU and intubated due to severe hypoxemic and hypercapnic respiratory failure. Patient was extubated on day 3 but subsequently developed severe respiratory distress. CXR demonstrated a large right sided pneumothorax. A 24 Fr chest tube was placed with complete expansion of the right lung. Resolution of air-leak was demonstrated on day 4 and chest tube removed. However, on day 7 patient developed worsening subcutaneous emphysema after exertion and a small pneumothorax was present on CXR. A narrow bore chest tube was placed. By day 14, air-leak continued with expiration. Using the same technique as in the first two cases, leak was isolated to RB8 using bronchoscopic insufflation. IBV valve was successfully placed with resolution of leak. Chest tube was removed the following morning and the patient discharged in the afternoon.

#### **DISCUSSION**

The successful use of one way valves for persistent air leaks due to both broncho-pleural and alveolo-pleural fistulae have been reported<sup>10-12</sup>. Secondary pneumothorax due to severe COPD generally is due to



**Figure 2.** Oxygen tubing connected to suction port of bronchoscope

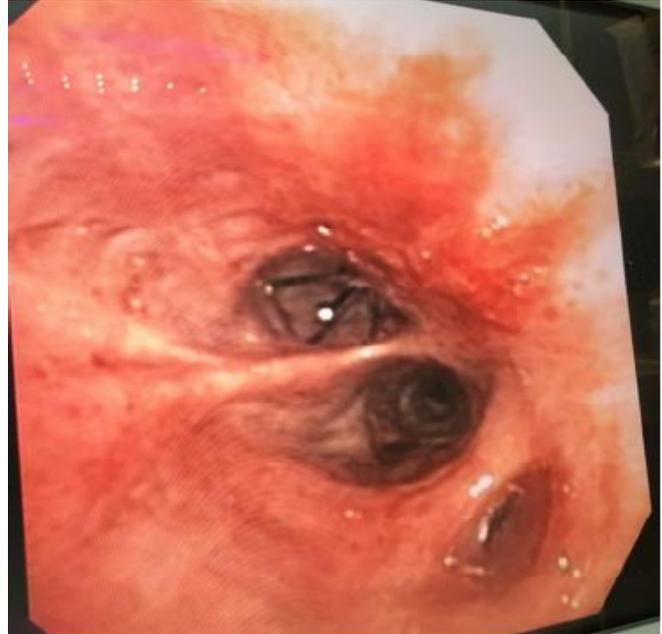
rupture of blebs, bullae, and resulting alveolo-pleural fistula. Several authors have reported the use of valves for treatment of persistent pneumothorax complicating various medical conditions including COPD. Travaline reported the use of valves (Emphysys) in 40 patients<sup>13</sup>. Twenty patients had a secondary pneumothorax. Gillespie et al reported the use of IBV valves (Spiration) in 7 patients<sup>11</sup>.

If the leak is present continuously, an inflation balloon can easily be used to isolate the leak. Generally, the balloon is inflated intermittently starting in lobar airways and then progressively distally. When a decrease or cessation of air leak is seen in the collection device, a valve can be placed. Often more than one valve must be placed if the leak arises from more than one segment. If the leak is not continuous, however, use of intermittent balloon occlusion to isolate the area of the leak can be difficult. We have found that a leak present only with expiration (“E” classification in the Cerfolio Classification System<sup>14</sup>) can often be elicited with use of a manual bag valve mask connected to an ET tube. But this technique does not work effectively in patients with small air leaks which are only present with forceful expiration (“FE” classification in the Cerfolio Classification System<sup>14</sup>) or cough. Even if a leak is seen using this technique, the leak may disappear once the bronchoscope is advanced into the ET tube due to increased resistance.

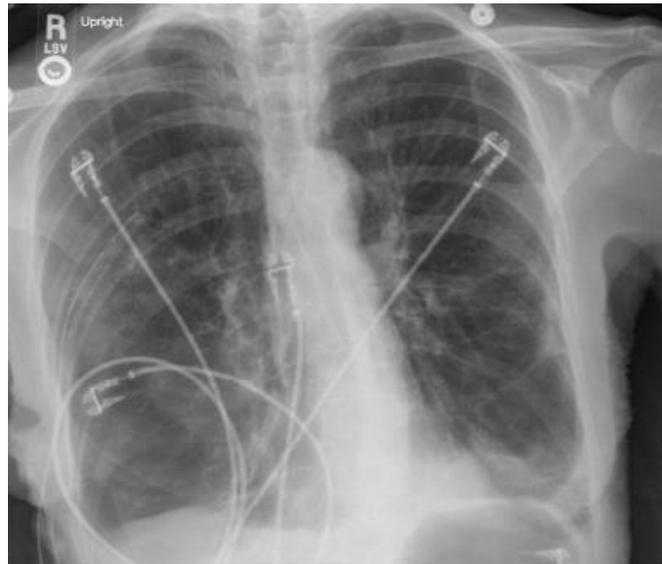
Vial et al recently described using bronchoscopic oxygen insufflation to isolate air-leak for IBV valve placement in 2 patients with broncho-pleural fistula after lung resection. Although there may be a concern for iatrogenic barotrauma with this method, Vial et al showed that airway pressure remained unchanged when oxygen was insufflated for 2 seconds. They further showed that the total volume of oxygen insufflated during the 2 second activation was less than 70ml<sup>9</sup>.

We demonstrate here that this technique can be used to localize small persistent air leaks present only with expiration or forceful expiration in COPD patients with secondary pneumothorax. Persistent air-leak due to secondary pneumothorax from COPD usually results from the formation of an alveolo-pleural fistula. These patients often have advanced disease and are

debilitated. Although surgical options are possible, many of these patients will not be surgical candidates and endoscopic closure techniques may present the best option. The use of bronchoscopic oxygen insufflation may allow the use of IBV valve closure for persistent airleaks due to alveolo-pleural fistula despite



**Figure 5.** IBV valve placed in RB8.



**Figure 4.** CXR shows complete expansion post IBV placement.

the presence of only intermittent air-leak with expiration or forced-expiration. In the era of emphasis on improving healthcare quality<sup>15</sup>, such techniques need to be studied further in the context of reducing costs (COPD is one of the top 20 expensive national conditions<sup>16</sup>) and improving patient centered care<sup>15</sup> (timely discharge).

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