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Selected Report

Successful Treatment of a Giant Emphysematous Bulla by Bronchoscopic Placement of Endobronchial Valves*

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Surgical bullectomy is the treatment of choice for giant emphysematous bulla. We report a case of successful nonsurgical treatment with bronchoscopic placement of one-way endobronchial valves that are currently under investigation for the treatment of end-stage emphysema. In patients who are poor surgical candidates, this noninvasive bronchoscopic treatment may represent a valuable alternative.

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Key words: bronchoscopy; emphysema; endobronchial valve; giant bulla; treatment

Abbreviations: EBV = endobronchial valve; GEB = giant emphysematous bulla; RV = residual volume; TLC = total lung capacity

Giant emphysematous bulla (GEB) is defined as a large bulla occupying at least one third of a hemithorax.[1] Bullae are thought to be in contact with the bronchial tree; they are preferentially filled during inspiration, causing collapse of the adjacent (more) normal lung parenchyma. The fact that they do not participate in meaningful gas exchange as well as their space occupancy (interfering with normal respiratory mechanics) leads to increased work of breathing with associated exercise limitation and dyspnea.[2] The natural history of GEB is one of enlargement causing worsening dyspnea; the rate of expansion, however, is unpredictable.[1] In patients with GEB occupying at least half of the volume of a hemithorax, surgical bullectomy is the treatment of choice.[3] Bullectomy causes significant improvements in dyspnea, gas exchange, pulmonary function, and exercise capacity, the best results being obtained in the larger GEB. Improvements persist for at least 3 to 4 years but start to decline afterwards.[3] Although reported early mortality rates after bullectomy are low (from 0 to 2.5%), surgery is not without risk in these compromised patients: complications include prolonged air leak for > 7 days (53%), atrial fibrillation (12%), postoperative mechanical ventilation (9%), and pneumonia (5%).[2] Safer alternative treatments therefore would be welcomed.

Endobronchial blockage with one-way valves (Zephyr; Emphasys Medical; Redwood City, CA) is a new bronchoscopic treatment approach developed to obtain less invasive, reversible, and safer lung volume reduction in patients with heterogeneous emphysema, as compared to classical lung volume reduction surgery.[4] Preliminary results in uncontrolled pilot studies[4] have been promising, and results of a multicenter, prospective, randomized controlled trial are awaited. We present a patient with a symptomatic, progressively expanding GEB at the left lower lobe that was successfully treated by bronchoscopic placement of four endobronchial valves (EBVs) in the left lower lobe segmental bronchi.

Case Report

A 57-year-old white man (ex-smoker, 12 pack-years) was referred to our clinic for treatment of a left lower lobe GEB. He had a history of bilateral pleuritis. COPD with emphysema was diagnosed in 1998. In 2003, CT scan of the thorax showed a large, 10 cm in diameter GEB at the left lower lobe. He was treated with tiotropium, 18 μg qd, and salmeterol-fluticasone, 50/5,000 μg bid. In 2005, he had progressively increasing dyspnea at exertion. Chest radiography showed a large GEB at the left lower hemithorax (Fig 1). CT scan confirmed the presence of a large, 20 cm in diameter GEB at the left lower lobe, with compression atelectasis of the adjacent pulmonary parenchyma (Fig 2). Pulmonary function tests showed a postbronchodilator FEV_1 of 0.91 L (29% of predicted); FEV_1/FVC ratio, 29%; total lung capacity (TLC), 8.68 L (133% of predicted); functional residual capacity, 6.35 L (186% of predicted); residual volume (RV), 5.55 L (245% of predicted); and diffusion capacity of the lung for carbon monoxide, 14.5 mL/mm Hg/min (54% of predicted).

A surgical bullectomy was proposed, but the patient was reluctant because of the morbidity and (small) mortality associated with this procedure, and he was referred for consideration of endobronchial treatment. After informed consent by the patient, rigid bronchoscopy (Storz; Tutlingen, Germany) was performed under total IV anesthesia (alfentanil, propofol, atracurium). Ventilation and oxygenation were assured using high-frequency jet

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FIGURE 1. Chest radiograph at presentation showing a large increase of the left lower hemithorax with increased hyperlucency, suggestive of a GEB ("vanishing lung").

ventilation delivered via the side port of the bronchoscope. Four Zephyr 4.0 EBVs were sequentially positioned in the four segmental lower lobe bronchi (B6, B8, B9, B10) through a large-channel flexible bronchoscope that was passed through the rigid bronchoscope, and following the instructions supplied with the valves. The procedure lasted 20 min and was uneventful. Subjective improvement of dyspnea was already noted on the next day, and the patient was discharged. One month after the procedure, there was a significant subjective improvement in dyspnea that was confirmed by pulmonary function testing (postbronchodilator FEV_1, 1.41 L [43% of predicted]; FEV_1/FVC ratio, 39%; TLC, 7.47 L [112% of predicted]; functional residual capacity, 5.06 L [147% of predicted]; and RV, 4.05 L [178% or predicted]). Diffusion capacity of the lung for carbon monoxide had remained unchanged (15.8 mL/mm Hg/min [57% of predicted]). At 3 months after the procedure, spirometric improvements were still present (postbronchodilator FEV_1, 1.43 L [44% of predicted]; FEV_1/FVC ratio, 38%), whereas TLC (7.12 L [107% of predicted] and RV (3.19 L [139% of predicted]) had improved even further. Chest radiography at 1 month after the procedure showed an almost complete disappearance of the GEB (Fig 3), which was confirmed by CT scan of the chest at 3 months (Fig 4).

FIGURE 2. CT scan of the thorax confirming the presence of a large (20 cm in diameter) GEB with compression atelectasis of the adjacent lung parenchyma.

DISCUSSION

This is the first reported case of successful treatment of a GEB using nonsurgical, bronchoscopic insertion of one-way EBVs. EBVs have been designed for palliative "nonsurgical lung volume reduction" treatment of severe heterogenous emphysema. The valve(s) allow drainage of air and secretions from the distal lung segment at expiration, while blocking air entry at inspiration, resulting in a redirection of airflow away from the blocked segments. Improvements in exercise capacity, pulmonary function, and quality of life have been observed in emphysematous patients, and are attributed to a decrease of (dynamic) hyperinflation. The principle of unidirectional airflow was used in this particular patient to "deflate" a GEB. Based on the same principle, EBVs have been used successfully in the bronchoscopic treatment of bronchopleural[5] and bronchocutaneous[6] fistulae.

The results of EBV insertion in this case report are

FIGURE 3. Postoperative chest radiograph 1 month after the procedure showing a marked reduction of hyperinflation and an almost complete disappearance of the giant bulla.

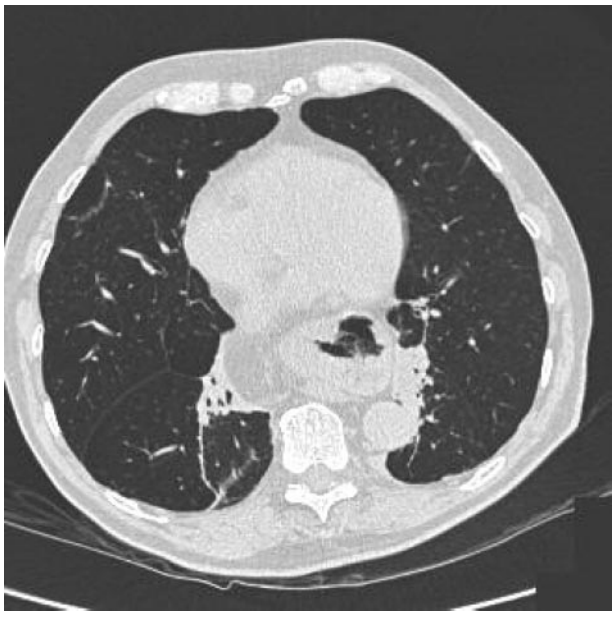

FIGURE 4. Postoperative CT scan 3 months after EBV placement showing a marked size reduction of the bulla.

encouraging. Interestingly, improvement in air trapping seems to be increasing with time, since reductions in RV and TLC were even more pronounced at 3 months after the procedure as compared to 1 month after valve placement.

Pending confirmation of success in other cases, as well as long-term safety and effectiveness data, bronchoscopic EBV treatment may become an attractive and valuable alternative to surgical bullectomy in patients with a GEB. Bronchoscopic EBV insertion indeed is easy, the insertion of valves is a safe procedure, and EBV insertion is easily and completely reversible since valves can be removed, if indicated, by forceps extraction using flexible bronchoscopy under local anesthesia.

REFERENCES

1 Meyers BF, Patterson GA. Bullectomy, lung volume reduction surgery, and transplantation for patients with chronic obstructive pulmonary disease. Thorax 2003; 58:634–638

2 Schipper PH, Meyers BF, Battafarano RJ, et al. Outcomes after resection of giant emphysematous bullae. Ann Thorac Surg 2004; 78:976–982

3 Palla A, Desideri M, Rossi G, et al. Elective surgery for giant emphysema: a 5-year clinical and functional follow up. Chest 2005; 128:2043–2050

4 Snell GI, Holsworth L, Bozzi ZL, et al. The potential for bronchoscopic lung volume reduction using bronchial prostheses: a pilot study. Chest 2003; 124:1073–1080

5 Ferguson JS, Sprenger K, Van Natta T. Closure of a bronchopleural fistula using bronchoscopic placement of an endobronchial valve designed for the treatment of emphysema. Chest 2006; 129:479–481

6 Snell GI, Holsworth L, Fowler S, et al. Occlusion of a broncho-cutaneous fistula with endobronchial one-way valves. Ann Thorac Surg 2005; 80:1930–1932

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