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Case report / Olgu Sunumu

Bronchoscopic volume reduction in severe emphysema

İleri düzey amfizemde bronkoskopik hacim küçültme

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For the past decade, volume reduction surgical intervention has been adopted for the management of end-stage emphysematous lung diseases, as an alternative to medical treatment. Within the same purpose, endobronchial volume reduction surgery has been used recently for the patients who are not eligible for surgery. In this article, we present a 55-year-old male patient with a significant bilateral lower lobe emphysematous lung disease accompanied by a forced expiratory volume in one second (FEV_1) value of 0.47 lt (13%). He underwent bronchoscopic occlusion of segmental and subsegmental bronchial occlusion using nine "Endobronchial Watanabe Spigot's" through rigid bronchoscope. After six months of follow-up, FEV_1 value was estimated as 0.74 lt (21%), which was nearly two-fold increase compared to preoperative levels. Total lung capacity and residual volume was reduced to 9.2 lt (102%) and 4.2 lt (150%), respectively. This minimal invasive endobronchial methods may be effective in patients who are in the waiting list of transplantation or ineligible candidates for surgery.

Key words: Bronchoscopy; emphysema; endobronchial treatment; volume reduction surgery.

Hacim küçültücü cerrahi girişim, son dönem amfizematöz akciğer hastalıklarında medikal tedaviye alternatif olarak son on yıl içinde gelişme göstermiştir. Aynı amaca yönelik olarak endobronşiyal hacim küçültücü cerrahi de son zamanlarda cerrahiye uygun olmayan hastalarda kullanılmaya başlanmıştır. Bu yazıda iki taraflı alt loblarda belirgin amfizematöz akciğer hastalığı mevcut ve birinci saniyedeki zorlu ekspirasyon volüm (FEV_1) değeri 0.47 lt (%13) olan 55 yaşında bir erkek hasta sunuldu. Hastamızda alt lob amfizematöz segmentlerin oklüzyonu, rijit bronkosokopi eşliğinde segment ve altsegment düzeyinde dokuz adet "Endobronchial Watanabe Spigot" konularak gerçekleştirildi. Olgumuzun altı aylık takip sonucunda FEV_1 değeri 0.74 lt (%21) olarak ölçüldü ve işlem öncesi değerlerin neredeyse iki katına ulaştı. Total akciğer kapasitesi ve rezidüel hacim sırası ile 9.2 lt (%102) ve 4.2 lt'ye (%150) geriledi. Bu tür minimal invaziv endobronşiyal yöntemler cerrahiye uygun olmayan ve nakil adayı olup bekleme listesinde bulunan hastalar için etkili bir yöntem olabilir.

Anahtar sözcükler: Bronkoskopi; amfizem; endobronşiyal tedavi; hacim küçültücü cerrahi.

The idea of surgical treatment for emphysema first began with Brantigan and Mueller in 1957[1] and more recently has been popularized by Yusen et al.[2] after their report on the long-term experience of 200 patients who underwent lung volume reduction surgery (LVRS). Several procedures have been performed in order to reduce both thoracic cavity and hyperinflated lung parenchyma.

The primary aim of LVRS (or bronchoscopic volume reduction) is to restore the radial traction of the terminal bronchi. The surgical removal of the hyperinflated parenchyma leads to reduced expiratory airflow obstruction and improved dyspnea. Recently, surgery for bronchoscopic volume reduction that obstructs the air passage up to a portion of the target area has evolved.[3]

Effective LVRS is efficacious in that it reduces a morbid and a major operation to a minimally invasive and repeatable procedure, and several devices have been developed to achieve this outcome. Now patients with

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unfavorable emphysematous disease as expressed in the National Emphysema Treatment Trial (NETT), the first multi-center clinical trial which was designed to determine the role, safety, and effectiveness of bilateral LVRS in the treatment of emphysema, can safely be performed.

CASE REPORT

A 53-year-old man was admitted to the hospital with shortness of breath. He had had severe dyspnea for approximately 10 years. A radiological evaluation revealed homogeneous emphysema on both sides of the hemithorax (Figure 1a). From a functional point of view, severe emphysema was detected since the forced expiratory volume in one second (FEV_1) was 0.47 lt (13%), total lung capacity (TLC) was 11.0 lt (153%) and residual volume (RV) was 6.85 lt (270%). He was referred to the surgical department as if volume reduction was possible. However, homogenous emphysematous areas were detected on chest tomography (Figure 1b-e) that precluded our ability to perform LVRS.

For this patient, we chose the placement of an endobronchial Watanabe spigot (EWS®) (Novatech, Plan de Grasse, France) to reduce the most hyperinflated segmental areas under direct vision of both a rigid and a flexible bronchoscope (Figure 2a). Nine blockers were placed, with four in the left lower lobe segments and subsegments (two in the posterobasal segment and two in the subsegments of the lateral basal segment) and five in the right lower lobe (two in the medial basal segment, two in the lateral basal segment, and one in the subsegment of the anterior basal segment). No pneumothorax was detected after the procedure. Early mobilization was achieved soon after the procedure with codeine medication. A chest X-ray verified that the spigots had been placed in the correct location (Figure 2b). The patient was discharged on postoperative day one, and the possibility of expectoration of the blockers was explained.

Two months after the placement, his exercise tolerance had markedly increased. After six months of follow-up, the FEV_1 was calculated at 21% (0.74 lt), nearly a two-fold increase compared with his preoperative levels, and the TLC and RV had been reduced to 9.2 lt (102%) and 4.29 lt (150%), respectively. He had also expectorated one of the blockers without any complications. His six-minute walking distance improved from 260 meters to 320 meters. Following the procedure, the patient was active daily while still undergoing medical treatment, but he no longer needed supplemental oxygen therapy.

DISCUSSION

Emphysema is a progressive disease that is the fourth leading cause of mortality.[4] Medical treatment with pulmonary rehabilitation is the primary selection of choice. However, even in the treatment group, progressive disease shows only a three-year survival rate of nearly 50%. Numerous procedures have been described to relief the dyspnea, but they have proven to be ineffective, except for lung transplantation and LVRS.

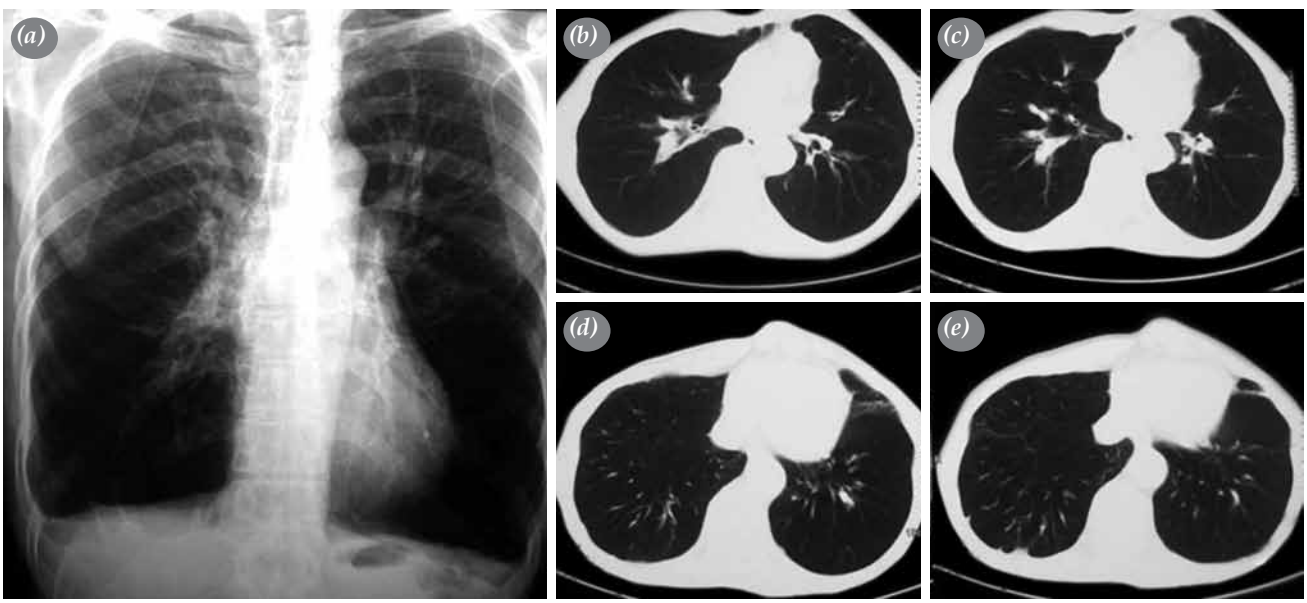

Figure 1. (a) Chest X-ray shows direct and indirect features of emphysema. **(b-e)** Computed tomography detects homogeneous emphysema.

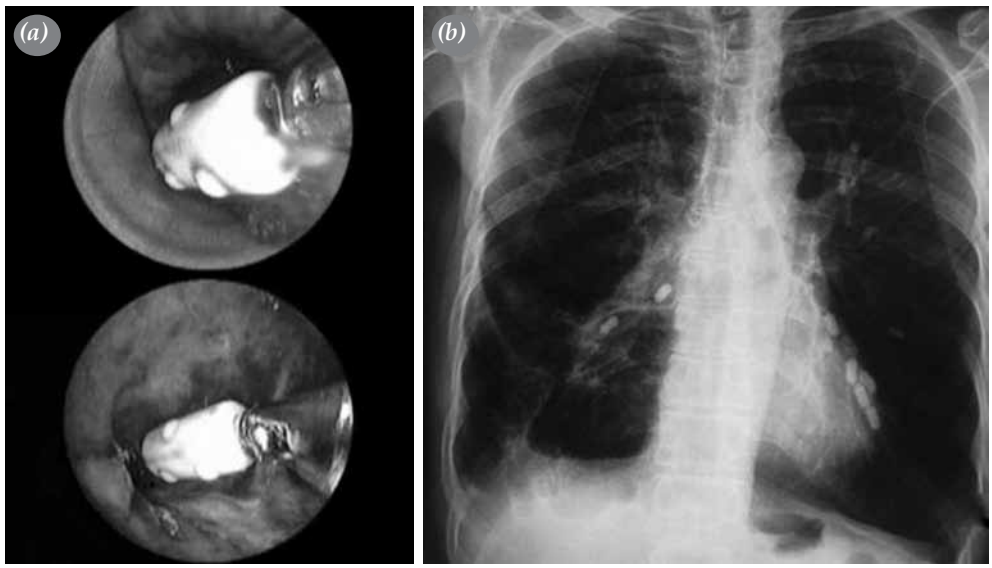

Figure 2. (a) This view shows the endobronchial application of the blockers in the segments. **(b)** Chest X-ray detects the adequate placement of the blockers.

The ideal candidates for LVRS are patients with localized hyperinflation areas with severe destruction of the lung parenchyma. The aims of the surgical removal of so-called "target areas" are the following: significant reduction of the dyspnea index with improvement of exercise tolerance, reduced intrathoracic pressure, and increases in elastic recoil and FEV_1. Obviously, not all emphysema patients are candidates for this type of surgery. For those patients, other less invasive and reproducible procedures have been investigated. For example, endobronchial treatment is one of the procedures that can be performed with either a flexible or a rigid bronchoscope that has been shown to be effective.[3]

Bronchial occlusion was first reported with the endobronchial Watanabe spigots in 63 patients with persistent air leaks and pulmonary fistulas, and 40% were successfully treated.[5] The first reported use of LVRS via the endobronchial method utilizing the Watanabe spigot took place in seven patients,[6] and functional benefit was achieved after the bronchoscopic placement of these blockers in those patients.

Apart from bronchoscopic blockers, other endobronchial valve devices have been designed which promote target area atelectasis by blockage of the air passage. Unfortunately, post-obstructive pneumonia is one of the consequences when these are used. However, neither the valves nor bronchial total occlusion lead to obstructive pneumonia in the majority of patients. One theory for this might be the blockage of bacterial contamination of the distal passage or the continuing mucous passage with the valves.[7] This procedure can be performed either under local or general anesthesia. Delivering and positioning the valves with a flexible bronchoscope can be challenging, especially in the upper lobe segment bronchi. Therefore, under general anesthesia, a flexible bronchoscope placed into a rigid bronchoscope is the simplest way of ensuring proper placement.

Toma et al.[8] used Emphasys© valves (Emphasys Medical, Inc., Redwood City, CA, USA) in eight patients for bronchoscopic volume reduction, and significant improvement was recorded in the FEV1 percentage, with up to a 34% difference. Newer, umbrella-shaped valves (Spiration© IBV) (Spiration Inc., Redmond Washington, USA) prevent air flow in the target area but allow mucus to exit. These devices have a Nitinol-covered polyurethane membrane. This valve system has been under investigation for use with severe emphysema,[9] but so far it has only been approved to control prolonged air leaks after lung resection. Except for the Watanabe spigots, none of these gadgets are commercially available in Turkey yet.

The literature related to LVRS indicates that patients with bilateral endobronchial valves have been treated in the same manner as our case. The early results of the use of endobrachial Watanabe spigots in our patient are encouraging, with nearly a 50% improvement in the FEV_1 (13% to 21%) after two months. Migration of the blockers indicates significant problems. Herein, the patient had expectorated one of the blockers, but his respiratory functions were still above the previous limits with increased exercise tolerance.

The early results for the use of these spigots is promising. For patients with an unfavorable surgical status or those on a waiting list for lung transplantation, this minimally invasive and reproducible procedure is as encouraging option.

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