Respiratory Medicine Case Reports 18 (2016) 81–84

Contents lists available at ScienceDirect

Respiratory Medicine Case Reports

journal homepage: www.elsevier.com/locate/rmcr

Case report

Unexpected improvements of lung function in chronic obstructive pulmonary disease

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ARTICLE INFO

Article history:
Received 9 November 2015
Received in revised form
10 May 2016
Accepted 11 May 2016

Keywords:
Chronic obstructive pulmonary disease
Forced expiratory volume in 1 sec
Giant bulla
Lung function
Pulmonary rehabilitation

ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is usually characterized by a progressive decline of lung function. We reported the 10 years follow-up of an elderly man, a heavy smoker with severe COPD and apical bullous emphysema. During 6 months pulmonary rehabilitation program the patient's clinical state improved significantly and it associated with a steep increase in forced expiratory volume in one second (FEV1). This case report elaborates on the unexpected gain of FEV1 in the follow-up of a COPD patient.

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1. Introduction

The primary pathophysiologic characteristic of Chronic Obstructive Pulmonary Disease (COPD) is airflow limitation caused by airway narrowing and loss of elastic recoil [1]. As the disease has a progressive nature, FEV1 usually declines over time [2]. So far, most treatments offer significant symptom improvements, reducing the frequency of exacerbations yet it does not affect the lung function decline, with the exception of smoking cessation [3]. In the management of COPD pulmonary rehabilitation plays a major role, as it has been shown to improve the quality of life, exercise capacity and symptoms on top of pharmacological treatment [4]. However, there is no evidence corroborating improvements in lung function with undertaking a pulmonary rehabilitation program. We report a case of a severe COPD patient whose pulmonary function improved significantly after following such a program.

2. Case report

A 66-year-old man with a smoking history of 18-pack-years was diagnosed with COPD in 1997. The man was treated with the standard inhalation therapy and smoking cessation one year after. At the time of diagnosis, lung function presented a forced vital capacity (FVC) of 3,56 L (81%pred.), forced expiratory volume in one second (FEV1) of 1,51 L (42%pred.), a FEV1/FVC ratio of 0.42, total lung capacity (TLC) of 6,63 L (96%pred.), a residual volume (RV) of 3,01 L (138%pred.) and a diffusing capacity (TLco) of 47%pred. Computed Tomography (CT) of the chest demonstrated diffuse emphysema with large apical bullae most pronounced in the left hemi-thorax. During yearly follow-up, the patient was reporting a stable dyspnea, particularly during moderate to intense physical activities (mMRC 2). There were no exacerbations. The repetitive pulmonary function tests demonstrated an expected further decline of FEV1 under maintenance therapy with long-acting B2 agonists and inhaled corticosteroids.

In September 2007, the patient was admitted to the hospital for bilateral pneumonia (most pronounced in the right middle lobe) for which he was successfully treated 3with conventional antibiotics during 7 days. Long-acting anticholinergics were added to the therapy. After discharge, the patient joined a pulmonary rehabilitation program for 6 months during which his clinical status drastically improved. Maximal exercise capacity at the start of the program (Watt: 60, VO2: 1173 ml/min, FEV1: 1.16 L, VEmax: 41 L/min) increased by more than 50% after 6 months training (Watt: 110, VO2: 1839 ml/min, FEV1:1.89 L, VEmax: 62 L/min). The 6 minutes walking distance increased with 205 m (from 401 m to 606 m).

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http://dx.doi.org/10.1016/j.rmcr.2016.05.004
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In August 2008, the patient visited the outpatient clinic for further follow-up. The FEV1 of 2.04 L or 62%predicted at that time was recorded and further maintained for the next 5 years (Fig. 1).

At the outpatient clinic, a junior doctor reported on the letter to the GP that rehabilitation resulted in clinically significant improvements in pulmonary function and exercise capacity. This statement may not be correct.

3. Discussion

"Pulmonary rehabilitation is a comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies, which include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease" [5]. A Cochrane review including 31 randomized controlled trials in COPD found clinically and statistically significant improvements in exercise capacity and quality of life following rehabilitation. On average the expected increase in VO2 is 10–20% of baseline and between 32 and 65 m for the 6 minutes walking distance [6]. Hence, there are no data supporting a raise in FEV1. In our case we observed a gain in lung function, maximal exercise capacity and 6 minutes walking test beyond all expectations. Although the effects of training on an individual may be much larger than the group average, most of the effect should be attributed to the larger maximal ventilation by a steep increase in FEV1. The latter is not explained by a spontaneous recovery of FEV1 post pneumonia, as baseline FEV1 values have been continuously lower for 10 consecutive years prior to the event.

If we take a closer look at lung function changes, deflation with the characteristic drop of RV and a corresponding increase in FVC and FEV1 occurred within a stable TLC. Although one may assume that the introduction of Tiotropium in the maintenance therapy resulted in static deflation, the magnitude of this response (almost 1.0 L) is too large to be true. Mean improvements in FEV1 with Tiotropium on top of LABA/ICS combinations are normally between 60 and 100 ml and although the individual effect-size may be much larger, other possibilities need to be considered [7]. We would recommend checking the X-rays, as we think of autobullectomy.

X-rays and CT scan confirmed our hypothesis; the giant bulla earlier seen in the right upper lobe disappeared (Fig. 2). Usually, pulmonary bullae gradually enlarge and spontaneous regression is very rare [8]. A Pubmed search revealed only 8 relevant articles with reference to the spontaneous resolution of pulmonary bullae, most often due to infection of the bulla (bullitis), leading to an autobullectomy. The assumption for the autobullectomy hypothesis

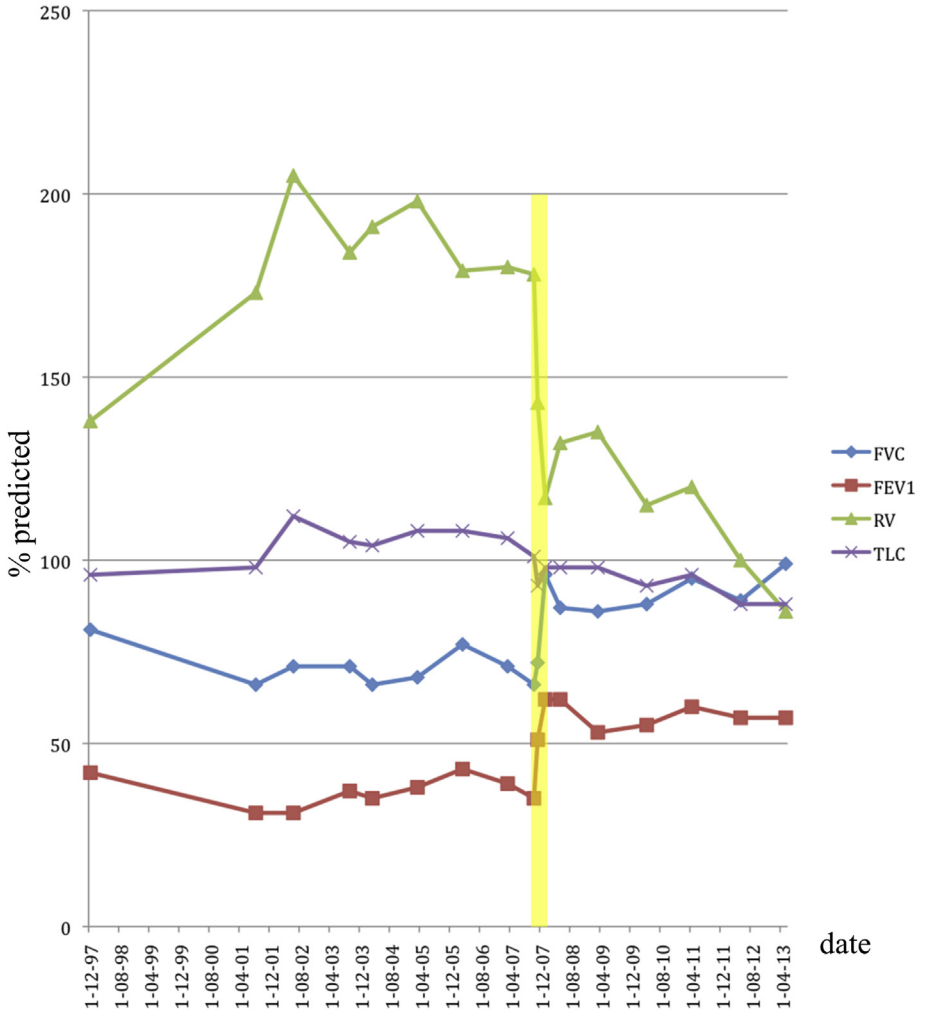

Fig. 1. Evolution of spirometry in time, with denotation of the 6-month period during which pulmonary rehabilitation was undertaken. FVC = Forced Vital Capacity; FEV1 = Forced Expiratory Volume. RV = Residual Volume. TLC = Total lung volume (data are presented as percent of predicted, ECSC values; lung volumes are measured by body plethysmography throughout whole period).

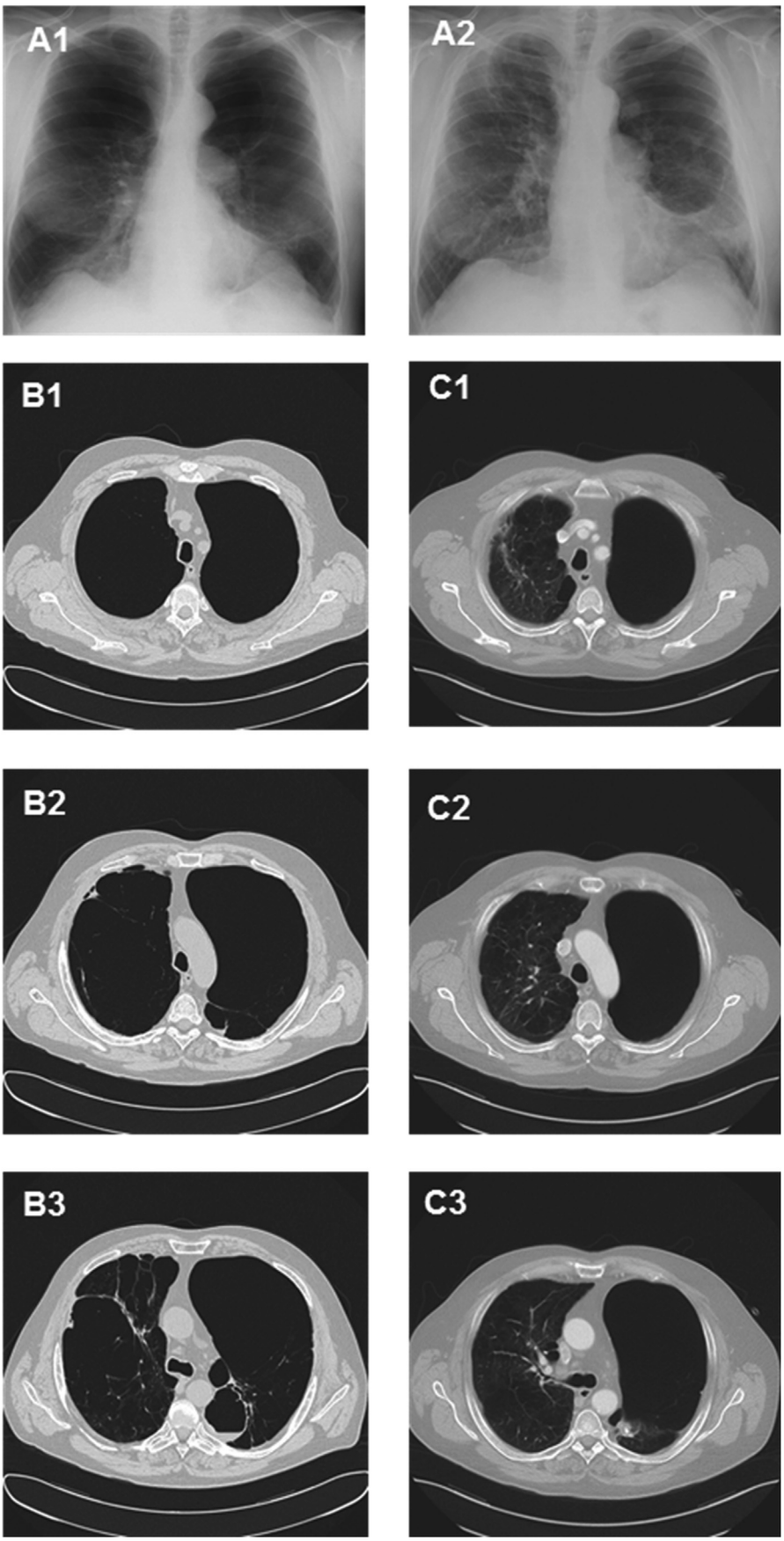

Fig. 2. A/X-ray of the chest before and after the pneumonia. B/CT images of the apical bullae before the infectious episode. C/Corresponding CT images 4 years after the infectious event.

is an inflammatory process (e.g. infection, tumor, blood clot) within the bulla leading to obstruction of the supplying bronchus and subsequent collapse.

Bullectomy should be considered when the hyperinflation is thought to contribute to dyspnea and exercise limitation. Other indications for surgical bullectomy are complications: hemoptysis, recurrent pneumothorax, and infectious bullitis. In the absence of any complication, experts recommend surgical bullectomy only when the bulla takes at least one third, preferably one-half, of the hemithorax [9]. In 2001, bullectomy was considered but not performed in our patient because of limited complaints and subjective wellbeing. In retrospect, given subjective and objective improvements in dyspnea and exercise capacity after autobullectomy, we may conclude that surgical bullectomy at the time of diagnosis would have been a good treatment option.

Conflict of interests

The authors declare that there is no conflict of interests.

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