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Primary Care of the Patient with Chronic Obstructive Pulmonary Disease—Part 4: Understanding the Clinical Manifestations of a Progressive Disease

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ABSTRACT

This article reviews the main factors influencing the pathophysiology, symptoms, and progression of chronic obstructive pulmonary disease (COPD), including dynamic hyperinflation, exacerbations, and comorbid illness. Key clinical trials and reviews were identified. After formal presentations to a panel of pulmonary specialists and primary care physicians, a series of concepts, studies, and practical clinical implications related to COPD progression were integrated into this article, the last in a 4-part mini-symposium. The main points of roundtable consensus were as follows: (1) COPD is characterized by declining pulmonary function as classically measured by forced expiratory volume in 1 second (FEV_1), but the complex pathophysiology and the rationale for bronchodilator therapy are actually better understood in terms of progressive hyperinflation, both at rest (static) and worsening during exercise (dynamic) and exacerbations; (2) although COPD progression is often thought of as inevitable and continuous, the clinical course is actually quite variable and probably influenced by the frequency of exacerbations; (3) preventing exacerbations with pharmacologic and nonpharmacologic care can influence overall morbidity; (4) comorbidities such as lung cancer, cardiovascular disease, and skeletal muscle dysfunction also contribute to declining patient health; and (5) surgical lung volume reduction and lung transplantation should be considered for selected patients with very severe COPD. We conclude that the concept of COPD as a gradual but relentlessly progressive illness that is best monitored via FEV_1 is outdated and likely compromises patient care. Many patients now being managed in primary care settings will benefit from an earlier, broad-based, and aggressive approach to management.

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Chronic obstructive pulmonary disease (COPD) is characterized by a progressive decline in pulmonary function that leads to increased dyspnea, exercise intolerance, and eventually respiratory failure. The decline in pulmonary function is most often portrayed—as in the classic diagram by Fletcher and Peto—in terms of forced expiratory volume in 1 second (FEV_1) (**Figure 1**).[1] This traditional view of COPD progression is reinforced not only by the treatment guidelines[2,3] and landmark smoking cessation studies[4] that have used FEV_1 as a gauge of disease severity but also by everyday clinical experience. By the time many patients are referred to a specialist, for example, the FEV_1 is often $<50\%$ of predicted, and these levels of moderate-to-severe disease tend to be associated with poor quality of life and systemic effects of the disease. At an FEV_1 around 30% of predicted, respiratory failure is increasingly likely.

Although FEV_1 is an appropriate and practical parameter for charting disease progression in patients with COPD,

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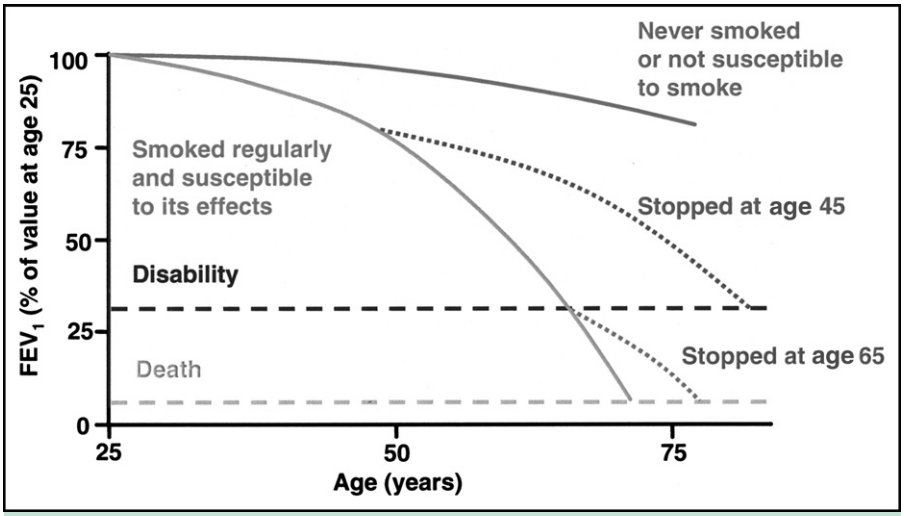

Figure 1 Traditional view of the progression of chronic obstructive pulmonary disease. FEV1 = forced expiratory volume in 1 second. (Adapted from *BMJ*.[1])

clinicians may be misled by this entrenched paradigm of a smoothly accelerating decline in lung function over the decades. The visual image itself conjures the flight of a heavy arrow—an arrow that has left the bow and whose smooth arc is predestined and unalterable.

This article asks primary care physicians to rethink that perception of COPD as a uniformly and unchangeably progressive disease. We begin by reviewing studies showing that progression of static and dynamic hyperinflation may offer more insight into COPD pathophysiology and progression than the simple FEV_1. Specifically, we show how hyperinflation closely correlates with patient-reported outcomes such as dyspnea, exercise performance, and quality of life and we also show how bronchodilator therapy can relieve both static and dynamic hyperinflation to produce impressive improvements in these important outcomes. In addition, we document that the seemingly smooth downward arc in FEV_1 may actually—in individual patients—be a more punctuated decline that is attributable to recurrent clinical or subclinical exacerbations. The potential impacts of systemic inflammation and comorbidities such as cardiovascular disease on disease progression are also described. Finally, in terms of management of later stage patients, the role of lung volume reduction is also briefly reviewed.

By rethinking the common view of COPD as an inevitably progressive disease, primary care physicians will be forced to rethink their management strategies for patients at all stages of the disease. This is entirely appropriate. Although COPD still cannot be cured, accumulating evidence indicates that it can be managed in a way that favorably alters the overall disease course in terms of symptoms, exercise ability, health status, complications, exacerbations, need for hospitalizations, and total costs of care for COPD.

HYPERINFLATION: ON THE OTHER SIDE OF OBSTRUCTION

In the clinic, obstructive lung disease can be easily identified and assessed in terms of its severity with a spirometer. This is true for both COPD and asthma. In both conditions, airflow obstruction is first identified as a reduction in the ratio of FEV_1 to forced vital capacity (FVC), e.g., $<70\%$. Beyond this the severity of the obstructive disease can be gauged by the FEV_1 as a percentage of a predicted value based on age and height. While important and highly practical, spirometry can only gauge the "downstream" side of the obstruction. In COPD, understanding the pathophysiology on the other side of the obstruction—lung hyperinflation—provides new perspectives on the progression and potential management of this chronic disease. In fact, hyperinflation explains many of the pathophysiologic manifestations of COPD and also correlates better than FEV_1 with important patient-reported outcomes.[5] In the recent national study of lung volume reduction surgery (LVRS),[6] for example, the FEV_1 was a poor predictor of exercise performance, dyspnea, and quality of life. One specific index of hyperinflation, the ratio of residual volume to total lung capacity, also has been shown to worsen with the progressive decline of FEV_1.[7]

Hyperinflation refers to the condition where both the total lung capacity and the residual lung capacity are chronically higher than predicted. Because the residual volume cannot be exhaled, these volumes cannot be measured by spirometry and special techniques such as body plethysmography (body box) are needed. With these techniques, static hyperinflation can be identified along with a high volume of so-called "trapped air." The patient with hyperinflation has difficulty with inspiration because the respiratory system moves on a relatively flat portion of its compliance curve and consequently there is increased elastic work of breathing. As COPD progresses, static hyperinflation gets progressively worse, and the operational