

COPD with Chronic Bronchitis and Bronchiectasis: A Case Study

Karen E. Conyers, RRT

Employed by Hill-Rom

Author Profile

Karen Conyers, as Regional Director for Hill-Rom, has contributed to a variety of research endeavors and developed white papers, case studies, and other supporting materials.

Case Study:

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Chronic obstructive pulmonary disease (COPD) ranks among the leading causes of adult morbidity and mortality worldwide, especially among smokers. An estimated 16 million Americans have the disorder.¹ The incidence of COPD is increasing, and illness-associated costs account for up to 15 % of sickness benefits.² With approximately 96,000 deaths annually, COPD places fourth as a cause of death in the United States.^{3,4}

Despite the enormous importance of COPD as a public health problem, there has been, until recently, limited progress in the understanding of the pathophysiology of the disease, and correspondingly few new treatments to control the relentless progression of airflow obstruction that defines the condition.⁵ New guidelines, however, identify preventive and therapeutic strategies that may slow disease progression, relieve symptoms, and improve quality of life.^{6,7}

In COPD, chronic airflow obstruction results from involvement of the small airways and loss of lung elasticity caused by enzymatic destruction of the pulmonary parenchyma. Experience indicates that such damage is largely irreversible. However, new evidence suggests that, in some individuals, disease progression may be controlled or even prevented by a combination of therapeutic interventions.⁸ Based upon improved understanding of the role of mucus as a vehicle of pulmonary destruction and its role in accelerating disease progression in COPD, treatment plans that include effective secretion clearance hold considerable promise.⁹

The present report describes significant, sustained clinical improvement with airway clearance therapy in an individual with advanced COPD.

Case Summary

The patient, a 53 year-old married white female, was referred to a major university medical center in Kansas for evaluation of a chronic cough productive of large volumes of grossly purulent sputum. She had a history of recurrent respiratory infections that had resulted in five hospitalizations in the past year.

In the months preceding her visit to the clinic, the patient reported producing one to one and a half cups of sputum daily and requiring 2.5 liters of supplemental oxygen per minute for 12 hours each night. During her visit, she complained of a stabbing chest pain, believed by the examining physician to be pleuretic. Shortness of breath limited her daily activity considerably. Depleted by her illness, the patient reported an inability to perform most daily activities. As a result, she felt discouraged and experienced episodes of depression. Significant medical history included asthma, diagnosed 20 years earlier, an episode of pneumothorax, and suspected COPD. Although the patient had quit smoking eleven years previously, her smoking history was estimated at 60-70 pack years. Family history revealed that both parents had been smokers and were diagnosed with emphysema; the patient's mother died of lung cancer at the age of 64.

Upon pulmonary examination, bilateral breath sounds were audible with a few expiratory wheezes at the lung bases; there were no rales. Chest x-rays revealed very prominent bronchial markings consistent with chronic bronchitis and possibly bronchiectasis; no acute infiltrates were identified. Pulmonary function tests (Table 1) indicated a markedly increased residual volume, slightly elevated total lung capacity, and moderately decreased transport factor (diffusion capacity).¹⁰

Table 1

Function	Measurement	%Predicted
FVC	1.09L	63%
FEV ₁	.65L	26%
FEF ₂₅₋₇₅	0.24 L/sec	9%
RV	2.83L	218%
TLC	6.33L	133%
TLCO	12.32L	57%

A polyp was found in the right nostril; there was no evidence of sinusitis. Other findings were unremarkable. The examining physician established a working diagnosis of COPD including components of emphysema, chronic bronchitis, and possible bronchiectasis. The overall clinical impression was

that of progressive pulmonary decline with anticipated total disability.

Method

Following consultation, the patient's current therapy was modified to include secretion clearance. Previously, she had taken Percocet for pain, two puffs Combivent TID, three puffs Vanceril inhaler TID, Albuterol nebulizer treatments PRN, and 2.5L/min oxygen nocturnally. She continued these treatments; in addition, an aggressive regimen of pulmonary hygiene was initiated, including routine use of aerosolized bronchodilators and airway clearance therapy to manage her copious secretions.

For secretion clearance, the patient's pulmonologist prescribed 30-minute treatments BID using The Vest™ Airway Clearance System. The Vest™ system provides therapeutic airway clearance treatments using high-frequency chest wall oscillation (HFCWO). To administer HFCWO, the vest component of the system is attached to an air pulse generator, which rapidly inflates and deflates the vest. Oscillation of the chest wall produces transient increases in airflow, cough-like shear forces, and changes in the rheological properties of mucus, making it easier to mobilize.

The Vest™ therapy was initiated in early October 1998. The patient was instructed to divide her 30-minute therapy sessions into three ten-minute intervals at 5-10 Hz, 10-15 Hz, and 15-20 Hz respectively.

Results

During the first several treatment sessions, the patient reported clearing large amounts of mucus. During a six-month follow-up interview, she indicated that the quantity of her daily secretions had decreased significantly, as well as the frequency and severity of her cough, even at night. She was able to reduce her use of nocturnal oxygen from twelve to eight hours. At a follow-up consultation, one full year after beginning The Vest™ system treatments, the patient had not experienced a single respiratory infection or required hospitalization.

In addition to clinical improvement, the patient described notable gains in her quality of life, permitting her first Christmas celebration in three years outside of the hospital. She reported an enhanced ability to perform activities of daily living, to enjoy

life more fully, and to maintain a cheerful, optimistic outlook. Significant relief of her chronic shortness of breath allowed her to participate in a broad range of activities including church events, shopping excursions, attendance at sporting and cultural events, and travel out-of-state to visit her ten grandchildren.

The patient was convinced that airway clearance therapy was the critical component in her treatment regimen. Except for a single week-long instance of omitting The Vest™ therapy while traveling out-of-state, her adherence to her airway clearance therapy remained strict.¹¹ Corresponding to the single lapse in treatment, she noted a rapid relapse including increased chest congestion and shortness of breath.

Discussion

It is no longer appropriate to consider mucus hypersecretion as an "innocent accompaniment of COPD".^{12,13} Recent investigators have observed a significant association between airway hypersecretion and all causes of mortality, and between illness and death among individuals with COPD in particular.^{14,15,16,17} In COPD patients with significant chronic bronchitis, pathogenic sequence of bronchial inflammation—characterized by neutrophil infiltration—results in increased protease activity. This leads to significant mucus hypersecretion, impaired mucus absorption, and damage to the mucociliary apparatus.¹⁸ In addition, toxic byproducts of inflammation precipitate rheological changes in airway mucus, making it thick, tenacious, and less clearable by cough.¹⁹ In the presence of chronic bronchitis, hypersecretion and inflammation of the bronchi and bronchioles contribute to airflow obstruction by effecting corresponding decreases in the caliber of airways.²⁰ Typically, small airways fill, and eventually plug, with large quantities of frequently purulent mucus.²¹ Retained mucus promotes establishment of bacterial colonies in those airways, thus setting up a relapsing and remitting clinical course.²² In such patients, microscopic examination of bronchial tissues demonstrates alternations in squamous epithelium, cilia, and associated structures.²³

In COPD patients with chronic bronchitis, clinical symptoms associated with airway obstruction and recurrent pulmonary infections are traceable, at least in part, to the biophysical consequences of mucus hypersecretion and impaired mucociliary clearance,

thus establishing a rationale for preventing prolonged contact of small and large airways with “toxic” mucus. Increasingly, strategies for the management of COPD, as well as guidelines for pulmonary rehabilitation, emphasize the importance of secretion clearance as a component of the treatment regimen.^{24,25,26}

Because this was not a formal study with controlled variables, it is impossible to assess how much HFCWO contributed to the clinical improvement and concurrent functional and quality of life gains experienced by the patient described in this report. However, prior to beginning HFCWO airway clearance therapy, this patient’s pulmonary function, physical stamina, emotional health, and quality of life were uniformly poor and declining rapidly. The Vest™ system was the significant variable in her treatment, and the qualitative improvements in her respiratory and physical status are evidenced by sharply reduced dyspnea. In addition to sustained gains in her general health, including freedom from pulmonary infections and increased respiratory stamina, the patient’s symptoms of anxiety, extreme fatigue, and depression subsided; her level of physical and social activity increased remarkably. This case suggests that further study is indicated concerning the role of HFCWO in the maintenance and rehabilitation of COPD patients with significant mucus hypersecretion.

References

¹ In the USA, an estimated 16 million persons had COPD in 1994—60% more than in 1982. In 1993, COPD was the fourth most common cause of death, resulting in 95,910 deaths—more than twice the 47,335 deaths in 1979. From 1979 to 1993, the age-adjusted COPD mortality rate increased almost 50% (from 14 to 20%), the all-cause mortality rate decreased 11%, and deaths attributed to cardiovascular disease declined. These data reflect that in contrast to cardiovascular mortality, COPD mortality is relatively insensitive to recent smoking cessation.

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⁴ In 1989, Feinleib et al. comprehensively reviewed mortality data from the U.S. and demonstrated a relatively persistent overall trend in deaths from 1950-1985, during which period the overall mortality from all COPD increased approximately fourfold. Absolute mortality rates in individuals aged 55-84 years in 1985 were approximately 200/100,000 for males and 80/100,000 for females. The dramatic increase in the incidence

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¹⁰ Pulmonary function tests have not been repeated since the patient began The Vest therapy. However, such scores fail to characterize the impact of COPD on a patients’ ability to perform activities of daily living (ADL). Because dyspnea, the chief symptom of COPD, most directly limits ability to perform ADL, reduction of dyspnea and improvement in ADL status are most meaningful. Celli BR. Chronic obstructive pulmonary disease. In: *Pulmonary Disease Diagnosis and Therapy: A Practical Approach*, Khan MG, Lynch JP III, eds. (Williams and Wilkins, Baltimore 1997). pp. 199-236.

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