

Richard ZuWallack

Associate Chief, Pulmonary and Critical Care, St. Francis Hospital & Medical Center, Hartford, Stany Zjednoczone
 Professor of Medicine, University of Connecticut School of Medicine, Farmington, Stany Zjednoczone

A history of pulmonary rehabilitation: back to the future

Historia rehabilitacji płucnej: nauki płynące z przeszłości

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Introduction

Pulmonary rehabilitation is defined as “an evidence-based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities. Integrated into the individualized treatment of the patient, pulmonary rehabilitation is designed to reduce symptoms, optimize functional status, increase participation, and reduce health care costs through stabilizing or reversing systemic manifestations of the disease” [1]. Pulmonary rehabilitation, which includes exercise training and education, has no direct effect on the airflow limitation such as the FEV₁, but it is highly effective because it reduces the systemic effects of the disease. For example, peripheral muscle dysfunction from physical deconditioning or other factors contributes substantially to effort intolerance in COPD. Exercise training in pulmonary rehabilitation can be highly effective in this area.

During the past three decades pulmonary rehabilitation has emerged as a standard of care for patients with COPD. This is exemplified by the Global Initiative for Obstructive Lung Disease (GOLD) [2] guidelines and the combined American Thoracic Society–European Respiratory Society statement on COPD [3] which both place this intervention prominently in their algorithms for COPD care. However, this was not the prevailing thought during the 1980’s and well into the 1990’s.

The rapid ascent of pulmonary rehabilitation was due in large part to the emergence of scientific studies that proved its effectiveness. Additionally, investigators demonstrated the physiologic underpinnings to improvements in exercise tolerance and dyspnea; this was very important since its lack of direct effect on FEV₁ probably hindered its acceptance by some in the medical community. Today, it is clear that pulmonary rehabilitation results in the greatest improvements in exercise tolerance, dyspnea, and quality of life than any intervention available. Emerging data also indicate that pulmonary rehabilitation also significantly reduces health care utilization.

1960’s to early 1990’s: pioneer era

Clinicians have long recognized (without strong evidence-based support) that comprehensive care programs have benefited their patients with COPD. Comprehensive care generally included breathing techniques, walking and other forms of exercise, oxygen therapy, and bronchial hygiene techniques [4] — the prototype of current pulmonary rehabilitation programs. For instance, Thomas Petty reported in 1974 that patients who participated in comprehensive care at his institution appeared to have fewer symptoms and hospital resource utilization than those who did not. Other pioneers in this field reported favorable effects on disease progression, activities of daily living, and quality of life [5]. Some comparison analyses sugge-

Adres do korespondencji: Richard ZuWallack, MD, e-mail: rzuwalla@stfranciscare.org

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sted that pulmonary rehabilitation might even confer a survival benefit [6]. Conclusions at this time were generally based on personal observations, comparison studies with similar untreated groups (but not part of a planned clinical trial), or before-after studies without randomization or control groups. The base of data supporting these conclusions was, therefore, limited — although the lack of scientific data does not necessarily mean the effect is not present.

1987: a change in focus on outcome assessment

In 1987 Gordon Guyatt and colleagues [7] reported on their development of a health-related quality of life questionnaire, the Chronic Respiratory Questionnaire (CRQ). This development was very important, since subsequent clinical trials of pulmonary rehabilitation often demonstrated very impressive improvement in this outcome area. The developing popularity of the timed walk test [8] also proved very useful to pulmonary rehabilitation. We then had two separate outcome areas that improve with pulmonary rehabilitation.

1991: a randomized trial of high versus low intensity exercise training in COPD patients

In 1991 Casaburi and colleagues reported on the physiologic effects of exercise training in 19 patients with COPD [9]. Up to this time a prevailing thought was that since COPD patients were ‘pump-limited’ they could not achieve meaningful physiologic benefits from exercise training. This small but well-designed study demonstrated that exercise training can indeed lead to physiologic improvements and — furthermore — these improvements were dose-dependent. This was followed by a succession of studies that demonstrated the physiologic underpinnings of exercise training in pulmonary rehabilitation.

1994: pulmonary rehabilitation improves dyspnea and quality of life

In 1994 Reardon and colleagues [10] demonstrated that exertional dyspnea measured on a treadmill improved following pulmonary rehabilitation compared to control patients who did not receive this intervention. This was the first controlled trial to demonstrate that pulmonary rehabilitation decreased dyspnea. A subsequent study by O’Donnell and colleagues [11] provided some of the physiological changes underlying this improvement. More recently, Porszasz and colleagues [12] demonstrated that, following 7-weeks’ exercise

training, dynamic hyperinflation was decreased at iso-work levels during exercise testing. Presumably, exercising with trained ambulatory muscles results in less ventilatory demand, allowing for a slower respiratory rate, more time for exhalation, and less dynamic hyperinflation. Since hyperinflation is an important factor in dyspnea, this may also explain some of the improvement in exercise tolerance and dyspnea following pulmonary rehabilitation.

In 1994 Goldstein and colleagues [13] demonstrated that pulmonary rehabilitation improved quality of life in a randomized controlled trial. This provided further support that pulmonary rehabilitation improves outcomes of importance to the patient — despite the fact that it has no significant effect on pulmonary function.

1995: the first large trial of comprehensive pulmonary rehabilitation

In 1995 Ries and colleagues [14] reported on their study of 119 COPD patients who were randomized to either 8 weeks of comprehensive outpatient pulmonary rehabilitation or 8 weeks of education only. Pulmonary rehabilitation resulted in improvements in exercise tolerance, symptoms, and self-efficacy for walking. Positive results tended to wane after one year.

1996: COPD — a disease of the muscles

In 1996 Maltais and colleagues reported that COPD patients had lower oxidative capacity in their skeletal muscles than normal subjects [15], and — in a subsequent publication [16] — that this was significantly improved following exercise training. Studies like this demonstrated that COPD is indeed a disease of the muscles — something that is potentially treatable by the exercise training component of pulmonary rehabilitation.

2000: pulmonary rehabilitation and health care utilization

Five years after the above-cited landmark study of pulmonary rehabilitation by Ries and colleagues, Griffiths and colleagues [17] reported on the largest, randomized trial to date. Still, this study had an n of only 200, which is meager compared to trials conducted by the pharmaceutical industry. Unlike the Ries trial which used an education comparator group, the Griffiths study control group was standard medical management. The investigators confirmed improvement in walking ability and health status. More remarkably, they did show

a decrease in health care utilization following pulmonary rehabilitation: a decrease in hospital days (but not hospitalizations) and primary care physician visits. This study thus provided evidence that pulmonary rehabilitation can potentially decrease health care costs. Subsequent, non-randomized multicenter studies in California [18] and Northeastern United States [19] further demonstrated decreased health care utilization.

There are probably several factors underlying this improvement in hospital resource consumption and other health care utilization, including the promotion of collaborative self-management strategies for the COPD exacerbation, the promotion of a healthy lifestyle including vaccinations, fostering better adherence with treatment, increased exercise capacity, and increased physical activity.

2001: pulmonary rehabilitation comes of age

In 2001 the Global Initiative for Obstructive Lung Disease (GOLD) 2 presented a workshop consensus report on COPD. This collaborative effort was launched in 1997 with combined support of the National Heart, Lung, and Blood Institute and the World Health Organization. The 2001 document listed pulmonary rehabilitation as an established treatment for COPD, and the 2003 update placed this intervention prominently in their algorithm for the management of stable COPD. This was a huge step in the acceptance of pulmonary rehabilitation as a gold standard for the care of COPD.

2003: pulmonary rehabilitation is more than just exercise training

In 2003 Bourbeau and colleagues [20] provided evidence that an outpatient self-management educational program had positive benefits, including an approximately 40% reduction in hospitalizations for COPD exacerbations and a 59% reduction in unscheduled physician visits. While this intervention was not pulmonary rehabilitation (it did not provide structure exercise training) it did demonstrate that the educational component is also important. To this point the educational component of pulmonary rehabilitation had received short shrift by many. The concept of collaborative self management in COPD has grown substantially since this time.

2008: brave new world

O wonder! How many goodly creatures are there here! How beauteous mankind is! O brave new world. That hath such people in't! [21]. This

positive (and naïve) view of the world of Miranda from William Shakespeare's *the Tempest* is perhaps shared by many who have 'walked the walk' of pulmonary rehabilitation through the years. It has come of age, with proof it is effective in reducing dyspnea, improving exercise capacity and quality of life, and reducing health care utilization. It is now prominently placed in guidelines, and has finally (July 2008) received US legislature support to create a Medicare pulmonary rehabilitation benefit. Indeed, pulmonary rehabilitation is on the rise.

Where do we go from here? Movement is necessary for continued life. Pulmonary rehabilitation must add science that helps us improve on its effectiveness. We must explore its effectiveness in respiratory patients with diseases other than COPD. Only a small fraction of patients with respiratory disease who might benefit from this intervention actually get it. We must improve on this through promoting it to healthcare professionals and patients, and pushing for greater funding. Pulmonary rehabilitation as a package or its components should be integrated into the overall care of individuals with COPD or in individuals at risk for COPD. This is, in essence, good medicine.

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