Review Article

Pulmonary rehabilitation: insight into current trends

Anabel Sciriha, Stephen Montefort

Abstract

Pulmonary rehabilitation is a widely accepted therapeutic tool used to improve the quality of life and functional capacity of individuals with chronic lung disease. It is a multidisciplinary, comprehensive program designed to optimise autonomy and physical performance in patients with chronic respiratory impairment. There is sufficient evidence to support the use of pulmonary rehabilitation for a subset of patients and to indicate that it can improve exercise tolerance and symptoms of dyspnoea, as well as enhance health-related quality of life of patients with COPD and other respiratory conditions. According to projections in the Global Burden of Disease Study, COPD will be the fifth leading cause of disability-adjusted-life-year loss worldwide in 2020.

The goal of pulmonary rehabilitation is to help the individual achieve the highest level of independent functioning by improving pulmonary function, increasing exercise endurance and exercise work capacity, reducing dyspnoea and normalising blood gases.

Locally, no pulmonary rehabilitation service as described by respiratory societies is offered. Therefore, this paper will look into the current research focusing on future recommendations for this service in the international setting with an aim of implementing this into the local health care system.

Keywords

Asthma, COPD, Pulmonary rehabilitation, chronic, acute

Anabel Sciriha* BSc (Hons), MSc (Sheffield), SRP
Mater Dei Hospital, Msida, Malta
Email: anabel.sciriha@gov.mt

Stephen Montefort MD, PhD
Consultant Respiratory Physician, Mater Dei Hospital

** corresponding author*

Introduction

Rehabilitation is the restoration of individuals to the fullest medical, mental, emotional, social and vocational potential the individual is capable of. The basic premise of all rehabilitation is that it is possible to effect positive change under the poorest circumstances imaginable and that no effect of illness save for death is absolute.[1]

Pulmonary rehabilitation is defined as a program for people who have chronic lung disease.[2] Its primary goal is to enable people to achieve and maintain their maximum level of independence and functioning. Although most pulmonary rehabilitation programs focus on people who have chronic obstructive pulmonary disease,[2] people with other types of lung disease may benefit as well. The most successful rehabilitation programs are those in which services are provided by a physiotherapist, nurse, doctor, psychologist or social worker, and a dietitian working as the pulmonary rehabilitation team to coordinate complex medical services.[3]

Optimal length of the rehabilitation phase

Despite the increasing propagation of the efficacy of pulmonary rehabilitation, there is no definitive proposal for the best training strategy[2-4] with variances in the duration and frequency.[5,6] Significant gains in exercise tolerance, dyspnoea, and quality of life have been observed following rehabilitation programs as short as 10 days[7] and others as long as 18 months[8] with gains in exercise tolerance reported to be greater in the latter.[9] Two randomised trials compared 3 months and 18 months of low-intensity exercise training. The longer intervention led to 6% increase in the 6 minute walk distance, 12% reduction in self-reported disability and faster completion of stair climbing and overhead tasks.[10] No differences though were seen in pulmonary function studies between groups, after training. The investigators concluded that the benefits achieved after short-term pulmonary rehabilitation began to decay once the intervention was terminated, despite encouragement to continue participation in a home-based or community-based programme. On the other hand, Foy *et al* [11] showed that only male patients achieved greater gains in Chronic Respiratory Disease Questionnaire scores following the 18-month program (compared to 3 months). In fact, more favourable scores than those in the short-term group were reported for dyspnoea, fatigue, emotional function and task mastery.

In a 2005 published prospective trial[12] involving seven outpatient programmes, patients achieved significant gains in exercise tolerance (6 minute walk distance), dyspnoea and

health status (Medical Outcomes Study 36-item Short Form and quality-of-life index) after 12 weeks of pulmonary rehabilitation. Following an additional 12 weeks of rehabilitation, exercise tolerance, but not health status or dyspnoea, outcomes improved further, suggesting that programme duration may not impact all outcomes equally. Also, in support of longer term exercise training, 6-month outpatient pulmonary rehabilitation programmes composed of moderate-to-high-intensity aerobic and strength exercise training led to significant improvements in exercise performance and quality of life.[13] Although this study did not compare the 6-month programme with a shorter one, the benefits gained following the 6-month training program persisted 18 months after the completion of rehabilitation.

Severe COPD patients were also found to achieve greater improvements in treadmill endurance, incremental shuttle walk distance, and quality of life following a 7-week outpatient pulmonary rehabilitation programme compared with an identical program of only 4 weeks duration. However, patients who underwent the 4-week programme were not reassessed at the 7-week time point to enable the direct comparison of outcomes.[9]

Overall, although some studies suggest that the duration of the pulmonary rehabilitation programme impacts exercise tolerance improvement, it is less clear that other outcomes such as health status or dyspnoea are similarly affected by programme duration. Randomised controlled trials have shown that short-term pulmonary rehabilitation (4 to 12 weeks) can reduce the number of hospitalisations, improve quality of life, reduce respiratory symptoms, improve exercise tolerance, increase self-efficacy, and improve the ability to perform activities of daily living. However, only a few studies have looked at the benefits of long-term (12 weeks or more) supervised pulmonary rehabilitation (Table 1).

It has not been established to what degree the benefits of short-term pulmonary rehabilitation diminish over time, how long these benefits persist with continued supervised intervention, or the optimal nature of long-term pulmonary rehabilitation intervention. The confounding effects of multiple study designs including varying durations of exercise, education, breathing retraining, and home exercise interventions have hindered solid conclusions about these issues.

Rehabilitation in the acute and chronic phase

Acute exacerbations of COPD represent a major burden for patients and health care systems.[13,14] They are a common reason for hospital admissions and severely affect health-related quality of life[15] and prognosis.[16] Mortality rates during hospitalisations are around 10%[17] and during the following year hospitalisation may be as high as 40%. From the health care provider's perspective, COPD is resource consuming[18] and about 10% of COPD patients suffering from acute exacerbations account for over 70 percent of costs caused by COPD, primarily due to emergency visits and hospitalisations.

Position papers of the American College of Physicians and American College of Chest Physicians provide recommendations on the management of acute exacerbations. However, no recommendations on how future exacerbations and hospitalisations could be prevented are indicated, despite this being one of the main goals of COPD management. One solution that has been adopted in clinical practice is to provide rehabilitative care after treatment of acute exacerbation including physical exercise, patient education focusing on self-management strategies and psychosocial support.

The rationale to offer rehabilitation in patients recently treated for acute exacerbation is to enhance quality of life, as in stable COPD patients[14] and modify factors associated with increased risk for post-exacerbation morbidity and mortality. Patients with frequent exacerbations have more pronounced skeletal muscle weakness and a more limited six minute walking distance, which is in turn a risk factor for exacerbations and mortality. Thus, respiratory rehabilitation may have the potential to reduce hospital admissions by improving exercise capacity. It is surprising that research on the effects of respiratory rehabilitation in patients after acute exacerbations, is very scant.

Randomised controlled trials evaluating the effects of pulmonary rehabilitation after hospitalisation for acute exacerbations of COPD,[19] report improvements in outcome measures at three months after hospital discharge with significant improvements in walking distance (p=0.0002), health status scores (p=0.002), all four domains of the Chronic Respiratory Questionnaire (dyspnoea, p=0.003; fatigue, p=0.004; emotion, p=0.008; mastery of tasks, p<0.001). Therefore, this trend showed that early intervention with pulmonary rehabilitation after a hospital admission for acute exacerbations of COPD is safe and leads to statistically and clinically significant short-term improvements in exercise capacity and health status.[19]

Compared to rehabilitation during stable periods, the effects of rehabilitation tend to be larger after acute exacerbations. Studies looking at the acute phase are relatively small in sample size, therefore there is the tendency to overestimate the effect of an intervention compared to large trials. Also, methodological limitations were found and one cannot exclude that the estimates provided by the meta-analyses represent overestimations of the effect of respiratory rehabilitation after acute exacerbation. Therefore, larger trials seem justified to challenge the data available.

When conducting studies post acute exacerbations, recruitment of patients may be difficult because not all of them may want to be randomly allocated to respiratory rehabilitation or conventional care, in a situation of poor health status. It must also be taken into consideration that exercise capacity is particularly low after acute exacerbations, and therefore the exercise programme should be designed carefully. Strength exercise and tolerable whole body exercise modalities such as interval exercise may be particularly suitable for these patients.[19] Rehabilitation may not only reduce the number of acute exacerbations, but also their severity. Patients may learn to notice imminent exacerbations and seek medical attention earlier leading to a shift from inpatient to the less costly outpatient treatment of acute exacerbations. The significant reduction in hospital readmissions is suggestive of a beneficial cost-benefit balance.

Table 1: *Reported durations and outcomes of pulmonary rehabilitation programmes. (RCT: randomized clinical trial; OP: outpatient, PRP: pulmonary rehabilitation programme, QOL: quality of life; PF: pulmonary function; NS: not significant)*

Duration of Pulmonary Rehabilitation

Study/ year	Study type	Country/Setting	No of Patients	Outcomes/results
Troosters *et al.* 2000	RCT: 6 *vs* 18 months *vs* usual care	Belgium/OP	100	Pulmonary function; exercise capacity; muscle strength; QOL Walking distance ($p<0.05$);exercise capacity ($p<0.02$); no significant effects of training programme on PF measures *vs* usual care; improved quadriceps strength ($p<0.05$) and QOL ($p< 0.001$)
Foy *et al.* 2001	RCT: short- *vs* long-term PRP	United States/OP	140	Four domains of CRQ. Significant changes in short *vs* long term in all domains
Green *et al.* 2001	RCT: single-blind; short *vs* long-term PRP	UK/OP	44	Endurance; HRQL CRDQ ($p<0.011$); dyspnoea ($p<0.021$), emotion ($p<0.003$), mastery ($p<0.027$)
Berry *et al.* 2003	RCT: single-blind; short *vs* long-term PRP	United States/OP	140	Physical function and disability; pulmonary function Disability: $p<0.016$ long- *vs* short-term Physical function: increased walk distance ($p< 0.03$ long term); stair climb time ($p< 0.05$) Pulmonary function: NS
Sewell *et al.* 2006	RCT conventional seven-week supervised program (n=50) or to a four-week supervised programme (n=50).		100	At seven-week follow-up, patients in the four-week program attained higher submaximal exercise performance times for a mean difference 124 seconds (p=0.024).

Pulmonary rehabilitation in respiratory conditions other than COPD

Although there are some studies stretching the beneficial role of pulmonary rehabilitation to other respiratory diseases, the reported evidence is highest for COPD.[19]

It is believed that pulmonary rehabilitation has positive effects in a large range of chronic pulmonary conditions including asthma.[20,21] The scientific rationale for providing pulmonary rehabilitation to patients with non-COPD diagnoses is the same as for COPD. As in COPD, persons with other forms of chronic respiratory disease commonly experience deconditioning and exercise intolerance, disabling symptoms of dyspnoea and fatigue, impaired health status and quality of life, systemic inflammation, nutritional impairments, and/or muscle dysfunction (related to deconditioning, loss of fat-free mass, and/or corticosteroid use) that collectively impair functional status along with abnormalities of pulmonary function.[20]

Modification of the relative emphasis on the core programme components and overall programme content may be required to maintain patient safety and to meet individual patient needs and goals which may differ from the standard goals for COPD.[2] Disease-appropriate and age-appropriate tools for the assessment of exercise capacity, health status, and quality of life should be utilised, and efforts must be made to integrate topics relating to non-COPD diagnoses in situations in which the patient group is composed predominantly of COPD patients.

Although most of the studies published to date, which investigate the outcomes of pulmonary rehabilitation for disorders other than COPD are uncontrolled trials or case series, randomized clinical trials are beginning to emerge[22,23] with the strength of existing evidence supporting pulmonary rehabilitation varying across the different diseases.

Importance of nutritional and psychological care

The need of a multidisciplinary programme also includes nutritional and psychological assessment. Nutritional depletion is commonly found in COPD patients and this affects both the respiratory and skeletal muscle function, contributing to an increased morbidity and mortality.[24] Schols and colleagues

found that patients who increased their weight by more than 2 kg had a significantly better survival, independently of their initial body mass index.[25] Because of the morbidity and mortality associated with underweight COPD patients, it is therefore being recommended that interventions should be extended to prevention and early treatment of weight loss, before patients become extremely wasted, and therefore put more emphasis on dietary change than on medically prescribed supplementation.[2,17]

The psychological input is also required as patients with chronic respiratory diseases have an increased risk for anxiety, depression, and other mental health disorders[26,27] leading to frustration with poor health and an inability to participate in activities which can present as irritability, and a hostile attitude toward others. In the later stages of respiratory disease, progressive feelings of hopelessness and inability to cope often occur. When psychologic support is provided within the rehabilitation setting, one will be able to help facilitate the adjustment process by encouraging adaptive thoughts and behaviours as well as helping patients to reduce any negative emotions present.

As is documented in a review of randomized studies, Griffiths and colleagues reported reduced symptoms of anxiety and depression following a 6-week pulmonary rehabilitation program, with symptoms of depression remaining significantly reduced at the 12-month follow-up.[28] Also, Emery and colleagues[29] found reduced anxiety and improved cognitive function following a 10-week pulmonary rehabilitation intervention.

Recommendations and conclusion

With a constant increase in COPD patients, and this disease ranking 4th for mortality and morbidity rates, more research in this field is required to further look into the above discussed issues in order to help the local development of the best pulmonary rehabilitation service for the treatment of respiratory patients. Coordination of services is very important, especially during episodes of exacerbation, which are characterized with high morbidity and a marked increase in use of health care resources.

References

1. Donner CF, Muir JF. Selection criteria and programmes for pulmonary rehabilitation in COPD patients. Eur Respir J. 1997;10:744-57.
2. Ries A, Bauldoff GS, Carlin BW, Casaburi R, ZuWallack R, Herrerias C. Pulmonary rehabilitation. Chest. 2007;131:4s – 42s.
3. Hill NS. Pulmonary Rehabilitation. Proc Am Thorac Soc. 2006,3:66–74.
4. Troosters T, Casaburi R, Gosselink R, Decramer M. Pulmonary rehabilitation in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2005;172:19–38.
5. Sewell L, Singh SJ, Williams JE. How long should outpatient pulmonary rehabilitation be? A randomized controlled trial of four-versus seven weeks. Thorax. 2006;61:767–71
6. Rossi G, Florini F, Romanoli M, Bellatone T, Luci S, Lugli D. Length and clinical effectiveness of pulmonary rehabilitation in out patients with chronic airway obstruction. Chest. 2005;127:105-9.
7. Votto J, Bowen J, Scalise P. Short-stay comprehensive inpatient pulmonary rehabilitation for advanced chronic obstructive pulmonary disease. Arch Phys Med Rehabil. 1996;77:1115–8.
8. Wijkstra PJ, TenVergert EM, van Altena R. Long term benefits of rehabilitation at home on quality of life and exercise tolerance in patients with chronic obstructive pulmonary disease. Thorax. 1995;50:824–8.
9. Green RH, Singh SJ, Williams J. A randomized controlled trial of four weeks versus seven weeks of pulmonary rehabilitation in chronic obstructive pulmonary disease. Thorax. 2001;56:143–5.
10. Berry MJ, Rejeski WJ, Adair NE. A randomized controlled trial comparing long-term and short-term exercise in patients with chronic obstructive pulmonary disease. J Cardiopulm Rehabil. 2003;23:60–8.
11. Foy CG, Rejeski J, Berry MJ. Gender moderates the effects of exercise therapy on health-related quality of life among COPD patients. Chest. 2001;119:70–6.
12. Verrill D, Barton C, Beasley W. The effects of short-term and long-term pulmonary rehabilitation on functional capacity, perceived dyspneoa and quality of life. Chest. 2005;128:673–83
13. Troosters T, Gosselink R, Decramer M. Short- and long term effects of outpatient rehabilitation in patients with chronic obstructive pulmonary disease: a randomized trial. Am J Med. 2000;109:207–12.
14. Puhan MA, Scharplatz M, Troosters T, Steurer J. Respiratory Rehabilitation after acute exacerbation of COPD may reduce risk for readmission and mortality – a systematic review. Respiratory Research. 2005;6:54.
15. Seemungal T, Donaldson G, Paul E, Bestall J, Jeffries D, Wedzicha JADW. Effect of Exacerbation on Quality of Life in Patients with Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 1998,157:1418-22.
16. Mannino DM. COPD: Epidemiology, Prevalence, Morbidity and Mortality, and Disease Heterogeneity. Chest. 2002;121:121S-126S.
17. Groenewegen KH, Schols AMWJ, Wouters EFM. Mortality and Mortality-Related Factors after Hospitalization for Acute Exacerbation of COPD. Chest. 2003;124:459-67.
18. Sullivan SD, Ramsey SD, Lee TA. The economic burden of COPD. Chest. 2000; 117:5S-9S.
19. Man WDC, Polkey MI, Donaldson N, Gray BJ, Moxham J. Community pulmonary rehabilitation after hospitalisation for acute exacerbations of chronic obstructive pulmonary disease: randomised controlled study. BMJ. 2004;329:1209–11.
20. Bingisser RM, Joos L, Fruhauf B, Caravatti M, Knoblauch A, Villiger PM. Pulmonary rehabilitation in outpatients with asthma or chronic obstructive lung disease A pilot study of a “modular” rehabilitation programme. Swiss Med Wkly. 2001;131:407–11.
21. Emtner M, Stalenheim G. High Intensity Physical training in Asthma. A 10 week rehabilitation programme. Chest. 1996;109:323-30.
22. Moorcroft AJ, Dodd ME, Morris J. Individualized unsupervised exercise training in adults with cystic fibrosis. Thorax. 2004;59:1074–80.
23. Spruit MA, Troosters T, Trappenburg JC, Decramer M, Gosselink R. Exercise training during rehabilitation of patients with COPD: a current perspective. Patient Educ Couns. 2004;52:243–48.
24. Prescott E, Almdal T, Mikkelsen KL, Tofteng CL, Vestbo J, Lange P. Prognostic value of weight change in chronic obstructive pulmonary disease: results from the Copenhagen City Heart Study. Eur Respir J. 2002;20:539–44.
25. Schols AM, Soeters PB, Dingemans AM, Mostert R, Frantzen PJ, Wouters EF. Prevalence and characteristics of nutritional depletion in patients with stable COPD eligible for pulmonary rehabilitation. Am Rev Respir Dis. 1993;147:1151–6.
26. Singer HK, Ruchinskas RA, Riley KC. The psychological impact of end-stage lung disease. Chest. 2001;120:1246–52.
27. Dowson CA, Cuijer RG, Mulder RT. Anxiety and self management behaviour in chronic pulmonary disease: what has been learned? Chron Respir Dis. 2004;1:213–20.
28. Griffiths TL, Burr ML, Campbell IA, Lewis-Jenkins V, Mullins J, Shiels K et al. Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a randomised controlled trial. Lancet. 2000;355:362–68.
29. Emery CF, Schein RL, Hauck ER, MacIntyre N. Psychological and cognitive outcomes of a randomized trial of exercise among patients with chronic obstructive pulmonary disease. Health Psychol. 1998;17:232–40.