original paper

Effect of once weekly pulmonary rehabilitation on exercise tolerance in patients with chronic lung disease

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Abstract

Background Pulmonary rehabilitation (PR) programmes improve exercise tolerance and reduce breathlessness in patients with chronic obstructive pulmonary disease.

Aim A retrospective audit was undertaken to assess the effectiveness of the pulmonary rehabilitation programme at Belfast City Hospital (BCH).

Methods Data from 74 patients who completed a six-week PR programme were reviewed. Exercise tolerance was assessed by the shuttle walk test (SWT), and breathlessness by the BORG scale. Paired t-tests were used for within group analysis.

Results The mean (SD) exercise tolerance assessed by the SWT improved significantly as did duration of individual exercises. Patients were able to exercise more without increasing their breathlessness or heart rate.

Conclusions This paper highlights the effect of PR on exercise tolerance and breathlessness in patients with chronic lung disease. The results compare favourably with published literature where more frequently supervised exercise sessions were provided.

Introduction

Chronic respiratory disease often leads to disabling breathlessness. Up to 90% of chronic respiratory diseases may be attributed to chronic airflow obstruction.[1] In a one year period between 1997 and 1998 there were 3,552 admissions to hospital in Northern Ireland with a primary diagnosis of chronic obstructive pulmonary disease (COPD).[2] In 1997, 369 males and 325 females in NI died from COPD.[3]

Recent guidelines for the management of COPD have been published by the British Thoracic Society (BTS).[4] These state that pulmonary rehabilitation (PR) programmes have been shown to improve exercise tolerance and reduce breathlessness and should be considered in moderate and severe disease.[4-10] The advantages of pulmonary rehabilitation in other respiratory conditions has also been demonstrated.[11] The aim of this study was to assess the effect of the pulmonary rehabilitation programme in Belfast City Hospital (BCH) on breathlessness and exercise tolerance in a group of patients with chronic lung disease.

Methods

Data from 74 patients with respiratory illness who completed the PR programme was used for this study. Patients were referred from routine out-patient clinics and excluded from PR if they had cardiovascular instability or significant musculoskeletal problems that would prevent participation in exercise.

Exercise tolerance assessment

The incremental shuttle walk test (SWT)[12] was used to assess baseline exercise tolerance. BORG[13] ratings of perceived breathlessness, heart rate (HR) and oxygen saturation (SaO_2) were recorded on assessment and at intervals throughout the programme. Patients attended a supervised out-patient PR programme of exercise and education once a week. Exercise comprised of a warm up (stretching and aerobic work for 10 minutes) and a series of 10 exercises (four upper limb, one lower limb, three thoracic mobility, two aerobic exercises) performed for a specific time starting with 30 seconds each. The length of time spent exercising was progressed weekly to maintain a BORG rating of 3 following each exercise. Patients were encouraged to repeat the 10 exercises unsupervised at home at least twice weekly, along with a daily walk. Educational sessions were provided by physiotherapists, respiratory nurse, nutritionist, doctor, occupational therapist and health promotion officer. These included breathing control, airway clearance techniques, relaxation, nutrition, medication, energy conservation and inhaler use. Patients were reassessed at the end of the six week programme and reviewed after six months.

Statistical analysis

Paired t-tests were used for within group analysis.

Results

There were 87 patients with COPD and 39 with other respiratory conditions referred for pulmonary rehabilitation (see Table 1). The programme was completed by 74 patients. Of the remaining 52 patients, four died (before starting), three were deferred for further investigation of hypoxia with exercise and 45 failed to complete all sessions.

Shortness of breath was the one factor that limited the ability to walk or exercise in 58 patients (75%). In the remaining patients, symptoms such as leg pain or arthritis did not prevent patients participating or exercising.

Exercise tolerance as assessed by the SWT increased significantly by 23m at the end of the six week programme. There was no significant change in peak physiological response to exercise. The parameters measured remained stable indicating that patients were able to exercise more without increasing their breathlessness or HR or dropping their SaO_2 (see Table 2). The duration of individual exercises increased significantly between week 1 and week 6 (ex=27 seconds, $p<0.05$).

At six months following completion of the programme, 34

Table 1. Patient diagnosis

Diagnosis	Total assessed n=126 (70 males)	Total completed n=74 (44 males)
COPD	87	53
Asthma	16	6
Bronchiectasis	7	4
Other (e.g. asbestosis, cancer, sarcoidosis, pneumothorax, kyphoscoliosis)	16	11

Table 2. Shuttle walk test (SWT) performance and physiological response to exercise at the beginning and completion of a six week pulmonary rehabilitation programme (n=74)

	Beginning mean (SD)	Completion mean (SD)	Mean difference (SD)	P value
SWT distance (metres)	153 (79)	176 (96)	23 (70)	0.01
HR	110 (17)	123 (26)	13 (27)	0.40
BORG	3 (1.3)	3 (1.5)	0 (1.4)	0.13
SaO2	89 (11)	90 (5)	1 (11)	0.47

patients had been reviewed. Some of the treatment-induced improvement in SWT performance was maintained (p=0.281). The mean (SD) SWT distance after six months was 14 (75)m greater than at baseline.

Discussion

In this study, a short out-patient programme of exercise and education improved exercise capacity in patients with chronic lung disease. Although uncontrolled, these results are in line with results of randomised, controlled trials (RCTs).[4-10] The magnitude of treatment induced change in exercise tolerance differs considerably between trials. Factors such as the differences in the length and frequency of PR programmes may be at least in part responsible for this. This theory is supported by recent evidence demonstrating that the benefit of PR is dose related.[14] While patients' exercise performance significantly improved in this study it remains unclear as to what extent this translates to an important clinical difference.[15-18,20]

Breathlessness is a common symptom. In this study, the majority of patients indicated that shortness of breath was the one factor limiting their ability to walk or exercise. The BORG scale is often used to measure exertional breathlessness. While peak BORG scores following exercise testing did not improve as in other studies,[9,12] patients were able to exercise more without increasing their breathlessness.

There is still some controversy regarding the long-term benefits of PR.[7,9,19] In the BCH programme there was still a trend towards improvement in SWT scores after six months. Further research is needed to assess whether increasing the frequency of supervised exercise sessions improves the outcome of pulmonary rehabilitation.

In conclusion, PR improves exercise tolerance and breathlessness in patients with chronic lung disease. The results of this study compare favourably with published literature where more frequently supervised exercise sessions were provided.

References

1. Herbst K, McNeill S, Threlfall E, Morgan MDL. British Lung Foundation survey of respiratory healthcare provision in Greater London. *Thorax* 2000; 54 (s3); A43.
2. DHSS Information and Analysis Unit. July 1999.
3. Annual Report of the Registrar General. 1977
4. British Thoracic Society Guidelines for the Management of Chronic Obstructive Pulmonary Disease. *Thorax* 1997; 52 (S5): S1-S28.
5. Wedzicha JA, Bestall JC, Garrod R et al. Randomised controlled trial of pulmonary rehabilitation in severe chronic obstructive pulmonary disease patients, stratified with the MRC dyspnoea scale. *Eur Resp J* 1998; 12: 363-9.
6. Goldstein RS, Gort EH, Stubbing D, Avednano MA, Guyatt GH. Randomised controlled trial of respiratory rehabilitation. *Lancet* 1994; 344: 1394-7.
7. Wijkstra PJ et al. Quality of life in patients with chronic obstructive pulmonary disease improves after rehabilitation at home. *Eur Respir J* 1994; 7: 269-73.
8. Wijkstra PJ, TenVergert EM, van Altena R et al. 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. Ries AL, Kaplan, RM, Limberg, TM, Prewitt, LM. Effects of pulmonary rehabilitation on physiologic and psychosocial outcomes in patients with chronic obstructive pulmonary disease. *Ann Intern Med* 1995; 122: 823-32.
10. Lacasse Y, Wong E, Guyatt G al. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. *Lancet* 1996; 348: 1115-9.
11. Foster S, Thomas HM. Pulmonary rehabilitation in lung disease other than chronic obstructive pulmonary disease. *Am Rev Respir Dis* 1990; 141: 601-4.
12. Singh SJ, Morgan MDL, Walters DS, Hardman AE. Development of a shuttle walking test of disability in patients with chronic airways obstruction. *Thorax* 1992; 47: 1019-24.
13. Borg GAV. Psychophysical basis of perceived exertion. *Med Sci Sport Exercise* 1982; 14: 377-81.
14. Green RH, Singh SJ, Williams J, Morgan MDL. A randomised controlled trial of 4 weeks versus 7 weeks of pulmonary rehabilitation in COPD. *Thorax* 2001; 56: 143-5.
15. Guyatt GH, Berman LB, Townsend M, Pugsley SO, Chambers LW. A measure of quality of life for clinical trials in chronic lung disease. *Thorax* 1987; 42: 773-8.
16. Jones PW. Issues concerning health-related quality of life in COPD. *Chest* 1995; 107: 187S-93S.
17. Jaeschke R, Singer J, Guyatt GH. Measurement of health status: Ascertaining the minimal clinically important difference. *Control Clin Trials* 1989; 10: 407-15.
18. Reardon J, Patel K, ZuWallacj RL. Improvement in quality of life is unrelated to improvement in exercise endurance after outpatient pulmonary rehabilitation. *J Cardiopulmon Rehabil* 1993; 13: 51-4.
19. Foglio K, Bianchi L, Bruletti G et al. Long-term effects of pulmonary rehabilitation in patiants with chronic airway obstruction. *Eur Respir J* 1999; 13: 125-1332
20. American Thoracic Society/American Lung Association. Pulmonary Rehabilitation-1999. *Am J Respir Crit Care Med* 1999; 159: 1666-82.

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