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Semi-supervised, domiciliary pulmonary rehabilitation programme: a controlled clinical trial

Key Messages

1. Pulmonary rehabilitation is proven to improve the functional level and quality of life (QoL) of patients with chronic obstructive pulmonary disease.
2. A semi-supervisory, symptom-limited free arm raising and stairs climbing exercise is safe and effective in improving functional outcome and QoL among the elderly nursing home residents.
3. Means have to be explored on how to sustain the treatment effect.

Introduction

Chronic respiratory problems constitute one of the major health care problems in Hong Kong. Patients suffer from intense physical and psychological stress as a result of primary deterioration of lung function, with resulting deconditioning and limited functional activity. The pulmonary rehabilitation programme[1] is an individually tailored, multi-disciplinary programme aimed at returning patients to their highest possible functional capacity. Meta-analysis, systematic reviews, and opinion leaders endorse its efficacy in improving exercise tolerance, maximal workload, and endurance of patients by different techniques.[2,3] A small pilot project involving 15 in-patients in Shatin Hospital using a 6-week in-patient programme also noted a reduction in perceived shortness of breath and an improvement in 6-minute walking distance. However, the cost incurred per in-patient was about HK$50 000. Other hospitals in Hong Kong have started an out-patient pulmonary rehabilitation programme. However, the majority of patients who are capable of attending an out-patient programme require either non-emergency ambulance transport system or have milder disease to start with. An alternative cost-effective domiciliary programme of proven value is required to improve the physical status of elderly people suffering from chronic respiratory problems in Hong Kong. We developed such a semi-supervised, domiciliary pulmonary rehabilitation programme targeted at institutionalised elderly with chronic respiratory problems, with the aim of improving their exercise tolerance and quality of life (QoL).

Objectives

The primary objective was to test the efficacy of a 12-week semi-supervised domiciliary pulmonary rehabilitation programme to improving exercise tolerance and QoL of elderly living in nursing homes. The secondary objective was to study whether any improvement can be sustained at 48 weeks.

Methods

This was a randomised, prospective, controlled interventional trial undertaken between November 1996 and December 1999, on nursing homes residents in the New Territories East region. All medically stable elderly patients (>60 years old), who fulfilled the American Thoracic Society criteria for chronic obstructive pulmonary disease (COPD), were cognitively able to have QoL measured and were current non-smokers, were potential subjects. Subjects were randomised based on the residing nursing homes to the interventional (exercise) or control (conventional) group after optimisation of medical treatments. For the exercise group, an exercise programme was taught to relevant patients and a designated health care assistant in the nursing home. The principle of the training programme was one of symptom-limited, endurance exercise training. The training included pursed-lip breathing, graded free weights arm raising, stepping exercise, and coordinated breathing in activities of daily living twice daily on 5 days per week. For the exercise training, during the first two weekly visits, the tolerance of patients to each activity (as limited by patient's perceived symptom) was assessed at baseline. Pursed-lip breathing was practised regularly. Arm raising above the shoulders was performed and the number of repetitive

Hong Kong Med J 2007;13(Suppl 5):S42-5

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Table 1. Comparison of demographic and physical conditions at baseline

	Control group (n=32)	Exercise group (n=43)	P value
Continuous variable*	Mean (SD)		
Age (years)	80.2 (6.6)	81.3 (5.8)	0.418
MMSE (0-30)	20.7 (4.8)	21.9 (4.8)	0.275
SPO_2 (%)	94.0 (4.2)	94.4 (2.9)	0.654
FEV_1 (% predict)	46.3 (13.7)	42.8 (20.1)	0.407
FER (FEV_1/FVC)	0.56 (0.1)	0.53 (0.12)	0.127
Exercise tolerance			
6MWT (metres)	232.4 (16.5)	249.5 (98.7)	0.505
Stairs walking (steps)	54 (39)	60 (41)	0.539
METS	6.89 (3.02)	3.87 (0.76)	0.000
Quality of life measure*	Median (IQR)		
GDS (0-15)†	3.0 (2.0-6.0)	5.0 (2.8-7.0)	0.214
PGMS (0-17)	13.0 (9.5-15.0)	12.0 (8.8-12.0)	0.371
SGRQ (0-100)†			
Symptom	46.7 (36.4-61.0)	54.7 (42.1-54.7)	0.097
Impact	19.8 (9.3-42.6)	33.3 (14.7-52.6)	0.177
Activity	38.9 (16.1-70.6)	49.3 (32.7-68.2)	0.063
Total score	26.7 (19.1-41.8)	42.5 (29.0-49.1)	0.017

* MMSE denotes Mini-Mental State Examination, SPO_2 oxygen saturation by pulse oximeter, FEV_1 forced expiratory volume in 1 second, FER forced expiratory resistance, FVC forced expiratory vital capacity, 6MWT 6-minute walking test, METS metabolic equivalents, GDS Geriatric Depression Scale, PGMS Philadelphia Geriatric Morale Score, and SGRQ St Georges Respiratory Questionnaire

† The higher the score, the poorer the condition

movements was stepped up at a biweekly interval. Likewise, for the stepping exercise, the number of steps per session was increased at a biweekly interval if the patient could tolerate. The research assistant reviewed the progress of each patient biweekly between week 3 and week 12 with the aim of upgrading the activity level. The total duration of physical training was 12 weeks. Control group had no specific physical training programme to improve exercise tolerance. Patients were encouraged to perform as much exercise as tolerated. Demographic data, exercise tolerance (6-minute walking test, stairs climbing, bicycle ergometry) and QoL scores (St Georges Respiratory Questionnaire [SGRQ], Geriatrics Depression Score [GDS], Philadelphia Geriatric Morale Score [PGMS]) were measured at week 0, week 12, and week 48. To compare pre- and post-treatment effects for individual patient, continuous variables were tested by paired *t* test. The unpaired student *t* test was used to compare the two groups regarding exercise tolerance. The non-parametric Mann-Whitney *U* test was used to evaluate for changes in SGRQ, GDS, and PGMS.

Results

Among the 75 subjects recruited, 43 received the intervention and 32 constituted the controls. In the first 12 weeks, eight subjects in the exercise group dropped out: two died, two were disqualified as they were still smoking, two had cancer, one was admitted to hospital, one moved out of the nursing home. Three of the controls dropped out: two moved out of their nursing home, and one was admitted to hospital during the same period. During the second follow-up (48 weeks), three subjects in the exercise group dropped out (two were readmitted to hospital, one died), as did six controls (three died, two declined follow-up, one was admitted to hospital). Baseline characteristics of the two groups are shown in Table 1. Among controls there were 15 males and 17 females and in the exercise group there were 22 males and 21 females.

At 12 weeks, there was no significant change in the physiological parameters between the two groups. However, there was significant improvement in stairs walking and SGRQ in favour of the exercise group (Table 2). The sub-total SGRQ score was also significantly different in the 'impact' and 'activity' scores. There was also appeared to be an improvement in SGRQ 'symptom' sub-score in the exercise group compared to the controls, although the difference did not reach statistical significance (Table 2).

At 48 weeks, there were no significant differences between the control and exercise groups in all the physiological, physical (exercise), and QoL parameters measured. In particular, the previous superiority in stairs climbing and SGRQ in exercise over control group had disappeared. The results are presented in Table 3.

Discussion

Results of our study are consistent with other published findings,[4,5] whereby the exercise group improved in stairs walking and in the SGRQ score at 12 weeks. The improvement in exercise over the control group was due to two reasons. The controls displayed a deterioration in the 6-minute walking test, stairs walking, GDS and SGRQ scores. In contrast, the exercise group displayed improvement in the corresponding parameters. It is known that both elderly and COPD patients are prone to deconditioning and this was evident in our controls. This deconditioing is reversible and with appropriate training; exercise tolerance can be improved, as illustrated in our exercise group.

Table 2. Exercise tolerance and quality-of-life assessment in the exercise and control groups at first follow-up (12 weeks)

Variable*	Control group (n=29)	Exercise group (n=35)	P value	Mean difference (95% CI)
Exercise tolerance	Mean (SD)			
6MWT (metre)	234.2 (109.8)	285.7 (109.1)	0.057	54.46 (-1.66 to 110.58)
Stairs walking (steps)	47 (37)	87 (62)	0.002	40 (14-67)
METS	4.18 (0.87)	4.36 (0.95)	0.484	0.1835 (-0.35 to 0.72)
Quality of life measures	Median (IQR)			
GDS (0-15)	4.5 (3.0-6.0)	3.0 (2.0-5.0)	0.064	
PGMS (0-17)	13.0 (10.5-14.8)	13.0 (11.0-15.0)	0.533	
SGRQ (0-100)				
Symptom	56.5 (35.9-66.5)	38.5 (24.0-52.1)	0.053	
Impact	19.5 (10.0-32.0)	11.1 (5.7-17.5)	0.020	
Activity	55.9 (30.5-76.0)	28.5 (15.5-44.0)	0.014	
Total score	32.2 (22.8-47.4)	19.9 (15.1-33.2)	0.010	

* 6MWT denotes 6-minute walking test, METS metabolic equivalents, GDS Geriatric Depression Scale, PGMS Philadelphia Geriatric Morale Score, and SGRQ St Georges Respiratory Questionnaire

Table 3. Exercise tolerance and quality-of-life assessment in the exercise and control groups at 48 weeks

Variable*	Control group (n=23)	Exercise group (n=32)	P value	Mean difference (95% CI)
Exercise tolerance	Mean (SD)			
6MWT (metre)	215.8 (113.8)	244.7 (123.5)	0.378	28.49 (-37.09 to 94.92)
Stairs walking (steps)	46 (25)	54 (38)	0.398	8 (-12 to 27)
METS	3.95 (0.86)	4.29 (1.24)	0.316	0.334 (-0.41 to 1.08)
Quality of life measures	Median (IQR)			
GDS (0-15)	4.0 (2.3-5.8)	4.0 (2.0-7.0)	0.875	
PGMS (0-17)	13.0 (11.0-14.0)	13.0 (10.3-14.8)	0.681	
SGRQ (0-100)				
Symptom	41.3 (27.3-53.1)	39.2 (24.8-51.5)	0.594	
Impact	18.9 (7.5-33.3)	13.5 (5.5-19.4)	0.138	
Activity	48.3 (30.7-65.0)	41.0 (29.6-58.2)	0.286	
Total score	31.3 (20.2-44.7)	24.0 (18.0-30.4)	0.107	

* 6MWT denotes 6 minutes walking test, METS metabolic equivalents, GDS Geriatric Depression Scale, PGMS Philadelphia Geriatric Morale Score, and SGRQ St Georges Respiratory Questionnaire

The long-term effects of the pulmonary rehabilitation programme were based on outcome measurements at 48-week follow-up. Comparing the trend with time between the exercise and control groups, the exercise group showed a trend towards improvement followed by a decline after discontinuation of the programme, while the control group had a pattern of progressive deterioration. Parameters representing exercise tolerance and QoL in the exercise group showed no significant difference compared to those at baseline, with the exception of the SGRQ which showed a sustained improvement. The findings are in agreement with those of previous studies.

There are several unique features in our study. First, we targeted the elderly population; the mean age of our subjects was 81 years and their mean forced expiratory volume in one second was 41% of predicted. Thus, these appear to be the oldest group of patients entered into a pulmonary rehabilitation programme described in the literature. Most previous studies described exercise training at in-patient or out-patient departments, and/or involved equipment/monitoring during training. Our training programme was more practical and applicable for community or nursing home–based training. It could be implemented in nursing home settings, where there is a lack of specialised training equipment and professional manpower to coordinate the programme. Moreover, it could be undertaken on very old subjects, and was feasible even for those with mild cognitive impairment. Most of the patients learned and grasped the exercise skills within 6 weeks, and they were able to continue it in their old-age homes without supervision. Potentially it could therefore benefit more patients. The authors found it important to facilitate exchange of ideas between subjects, so that they learnt inhaler techniques from one another, undertook morning exercises together, and checked each other's breathing technique, and exercise training. Effectively a 'patient self-help group' was established in the nursing home and patients were empowered in the control of their symptoms and disease. The role of this 'patient self-help group' needs further exploration in future.

Conclusions

It is feasible and safe to develop a domiciliary pulmonary rehabilitation programme targeted at the elderly with COPD living in nursing homes. There is substantial evidence that a short-term pulmonary rehabilitation programme is effective in improving exercise tolerance and QoL, but when the programme is discontinued there is a deteriorating trend in

QoL and exercise tolerance. Both the moderately old and the very old can benefit from these types of pulmonary rehabilitation programmes.

Acknowledgements

This study was supported by the Health Services Research Fund (#531017). We would like to thank staff of all the nursing homes who participated in the programme.

References

1. Lacasse Y, Wong E, Guyatt GH, King D, Cook DJ, Goldstein RS. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. Lancet 1996;348:1115-9.
2. Pulmonary rehabilitation: joint ACCP/AACVPR evidence-based guidelines. ACCP/AACVPR Pulmonary Rehabilitation Guidelines Panel. American College of Chest Physicians. American Association of Cardiovascular and Pulmonary Rehabilitation. Chest 1997;112:1363-96.
3. Donner CF, Muir JF. Selection criteria and programmes for pulmonary rehabilitation in COPD patients. Rehabilitation and Chronic Care Scientific Group of the European Respiratory Society. Eur Respir J 1997;10:744-57.
4. Couser JI, Guthmann R, Hamadeh MA, Kane CS. Pulmonary rehabilitation improves exercise capacity in old elderly patients with COPD. Chest 1995;107:730-4.
5. Roomi J, Johnson MM, Waters K, Yohannes A, Helm A, Connolly MJ. Respiratory rehabilitation, exercise capacity and quality of life in chronic airway disease in old age. Age Ageing 1996;25:12-6.