Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.279601.3285 Volume 30, Issue 9.1, December. 2024, Supplement Issue
Manuscript ID ZUMJ-2403-3285
DOI 10.21608/zumj.2024.279601.3285
Original Article

Evaluation of Short versus Long Course Pulmonary Rehabilitation Program among Stable Chronic Obstructive Pulmonary Disease Patients

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Submit Date 26-03-2024
Revised Date 01-04-2024
Accept Date 02-04-2024

ABSTRACT

Background: Exercise tolerance and health-related quality of life (HRQL) are enhanced in patients with chronic obstructive lung disease (COPD) by pulmonary rehabilitation. This study aimed to evaluate the effect of PR program both short and long course among stable COPD patients to improve their tolerance and outcome. **Methods:** This non randomized clinical study was carried out at Chest Disease Department at Pulmonary Rehabilitation Unit of Zagazig University Hospitals on 30 Stable COPD patients during the period from July 2023 to February 2024 to assess the effect of PR program both short and long course among stable COPD patients to improve their tolerance and outcome. **Results:** There is a significant improvement in pulmonary function tests (FEV1/FVC, FEV1, FVC) (predicted %), Oxygen saturation, 6MWD and Quality of life score after long PR course compared to short PR course. Also there was significant decrease in mMRC after long PR course compared to short PR course. **Conclusions:** Pulmonary Rehabilitation program should be conducted for all COPD patients, improving dyspnea, exercise tolerance,and quality of life and. For best results exercise should continue for long course of Pulmonary Rehabilitation.
Keywords: Pulmonary rehabilitation, COPD, Physical activity

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the most common chronic lung disease and a major cause of lung-related death and disability. Chronic obstructive pulmonary disease (COPD) affects about 300 million people worldwide, resulting in approximately 64 million disability-adjusted life years [1].

COPD is the third most common cause of death in the world. In Egypt, COPD is a rising significant health problem; however, information on its prevalence, morbidity and mortality is still lacking. The prevalence of COPD among high-risk individuals in Egypt was estimated to be about 10% as per Global using Initiative for Chronic Obstructive Lung Disease (COLD) [2].

Global Initiative for Chronic Obstructive Pulmonary Disease [3] defined COPD as a heterogeneous lung condition characterized by chronic respiratory symptoms (dyspnea, cough, sputum production and/or exacerbations) due to abnormalities of the airways (bronchitis, bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, airflow obstruction. Exacerbations of COPD are important events in the management of COPD because they negatively impact health status, rates of hospitalization and readmission, and disease progression [3].

Pulmonary rehabilitation (PR),is defined by the American Thoracic Society/European Respiratory Society (ATS/ERS) as a ‘comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies that include, but are not limited to, exercise training, education and behaviour change, designed to improve the physical and

psychological condition of people with chronic respiratory disease [4].

Exercise training, widely regarded as the cornerstone of pulmonary rehabilitation is the best available means of improving muscle function in COPD patients. It is indicated for patients who have decreased exercise tolerance, exertional dyspnea or fatigue, and/or impairment of activities of daily living [5].

This study aimed to evaluate the effect of PR program both short and long course among stable COPD patients to improve their tolerance and outcome.

METHODS

This This non randomized clinical study was carried out at Chest disease department at Pulmonary Rehabilitation Unit of Zagazig University Hospitals on 30 Stable COPD patients during the period from July 2023 to February 2024. All patients were experienced program at 6 weeks and 12weeks. Every patient provided written informed consent, and the research ethics committee of Zagazig University's Faculty of Medicine authorized the study (Institutional review board) ZU-IRB (#10936-5-7-2023)

Inclusion criteria: COPD is diagnosed according to GOLD criteria (FEV1/FVC<0.7) based on post-bronchodilator FEV1; GOLD2&GOLD3; including moderate to severe degree COPD classification. Free from exacerbation 4 weeks before starting pulmonary rehabilitation under conventional therapy. mMRC (2-4) with limitation of physical activity despite optimal medical treatment. Non-obese patients with BMI<30kg/ m^2

Exclusion criteria: Unstable cardiovascular condition or recent (less than 6 months)/myocardial infraction. Previous pulmonary or cardiac surgery. Associated severe neuromuscular and orthopedic pathologies affect exercise safety. Uncontrolled Diabetes or Hypertension. Lack of interest to be included in the program. Untreated psychiatric illness and cognitive impairment

The following were done for all patients: Pre-PR program assessment included taking full medical history (smoking, symptoms dyspnea cough expectoration wheezing suggestive COPD .Clinical and radiological X RAY, High-resolution computed tomography (HRCT) assessment when needed

Pulmonary spirometry/stable COPD is diagnosed and classified as regards severity according's to GOLD criteria.

In COPD patients (FEV1/FVC < 0.7):

GOLD 1:	Mild	FEV1 ≥ 80% predicted
GOLD 2:	Moderate	50% ≤ FEV1 < 80% predicted
GOLD 3:	Severe	30% ≤ FEV1 < 50% predicted
GOLD 4:	Very Severe	FEV1 < 30% predicted

- laboratory assessment CBC – FBS – LFT – KFT – Lipid profile – TFT – ESR – CRP before program assessment.

- The degree of dyspnea associated with the activities was measured by mMRC before the program and after the program at 6 and 12 weeks.

Grade 0: I only get breathless with strenuous exercise

Grade 1: I get short of breath when hurrying on level ground or walking up a slight hill

Grade 2: On level ground, I walk slower than people of the same age because of breathlessness, or I have to stop for breath when walking at my own pace on the level

Grade 3: I stop for breath after walking about 100 yards or after a few minutes on level ground

Grade 4: I am too breathless to leave the house or I am breathless when dressing

- Oxygen saturation before the program and after the program at 6 and 12 weeks.

- The 6MWT test before the program and after the program at 6 and 12 weeks

- Quality of life assessment by validity questionnaire 11 before the program and after the program at 6 and 12 weeks.

	English
Information	The following sentences express feelings about the consequences of COPD. For each sentence, tick the intensity that best reflects your feeling at this moment (from "not at all" to "extremely"). There are no wrong answers. Each one is personal.
Dyspnea	*I suffer from breathlessness*
Anxiety	*I am worried about my respiratory condition*
Closeness	*I feel my entourage (family, friends, etc.) misunderstands me*
Mobility	*My respiratory condition prevents me from moving about as easily as I would like*
Sleep	*I feel sleepy during the day*
Life project	*I feel unable to achieve my objectives*
Fatigue	*I quickly get tired when doing day-to-day activities*
Physical confidence	*Physically, I am dissatisfied with what I can do*
Social life	*My respiratory disease disrupts my social life*
Depression	*I feel sad*
Emotional life	*My respiratory condition restricts my emotional life*

Rehabilitation program applied for Test group for 12 weeks

Education Program:

The minimum education included the provision of written material or a brief structured verbal interaction between a healthcare professional and a patient. However, it had to be part of a formal

program, in which the first objective was to improve knowledge and understanding of COPD. The educational program could be focused on smoking cessation, instruction in breathing techniques, improving lifestyle, self-management during exacerbations, ability to perform daily activities or a combination of the above.

Exercise training: 3- session per week for 12 weeks

Training both upper and lower extremities

Aerobic exercise Upper Limb (Arm cycling) lower limb (Cycle ergometer – Treadmill walking)

Physical exercise. Warming up phase. Cool down phase.

Resistance exercise Upper Limb (Free weight lifting – Ball exercise – Elastic band) Lower Limb (Free weight lifting – Ball exercise – Elastic band) [6]**.**

Inspiratory muscle training using incentive spirometer device.

Breathing re-training techniques: Breathing retraining techniques, include: low frequency breathing; pursed lips breathing; abdomino-diaphragmatic breathing. The common aim is to enhance tidal volume and lowers respiratory frequency without affecting the duty cycle fraction of inspiration to total duration of breathing cycle. Pursed lips breathing may modulate expiratory airflow, avoiding dynamic airway collapse. Diaphragmatic breathing, (slower and deeper inspiration) with increased oxygenation and better utilization of accessory muscles, and decreased dyspnea during exercise.

Post PR Assessment after 6 weeks (short course program) and 12 weeks (long course)

mMRC to assessed degree of breathlessness. Oxygen saturation. 3.PFT using spirometry to assessed degree of COPD according to GOLD [3] criteria. 6-MWT test. VQ11 questionnaire after PR.

Statistical analysis: All data were collected, tabulated and statistically analyzed using SPSS 26.0 for windows (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean ± SD & range , and qualitative data were expressed as absolute frequencies (number) & relative frequencies (percentage). t (student 't) test was used to compare between two groups of normally distributed variables . Mann-whitnney test was used to compare between two groups non-normally distributed variables. Paired t test was used to compare between paired normally distributed variables. Percent of categorical variables were compared using Chi-square test. All tests were two sided. p-value < 0.05 was considered statistically significant p-value ≥ 0.05 was considered statistically insignificant.

RESULT

Table (1) showed that this study included 30 patients with mean age of 51.0±4.6 years, they were 23 patients (76.7%) males and 7 patients (23.3%) were females and mean BMI of 26.85±1.53, according to dyspnea measured mMRC scale, grade 2 was the most in 16 patients (53.4) and according to staging severity of COPD grade 2 was the most in 17 patients (56.7)

Table (2) showed that there is a significant improvement percent in pulmonary function tests by (0.56%,0.02%&,4.8%), for FEV1/FVC, FEV1, FVC respectively, after long PR course compared to short PR course, $p<0.05$, also there was a significant improvement in short course compared to Pre- pulmonary rehabilitation. Table (3) showed that there is a significant improvement for oxygen saturation, after long PR compared to short PR program , $p<0.05$, also there was a significant improvement in short course compared to Pre- pulmonary rehabilitation. Table (4) showed that there is a significant decrease in mMRC, by (23.81%,), moreover there is significant improvement in 6MWD by (6. 36%), after long PR course compared to short PR course, $p<0.05$, also there was a significant improvement in short course compared to Pre- pulmonary rehabilitation. Table (5) showed that there is a significant improvement percent in Quality of life score by (-11.63%, -19%), respectively, after long PR course compared to short PR course, $p<0.05$, also there was a significant improvement in short course compared to Pre- pulmonary rehabilitation.

Table (1) Patients' characters of studied groups.

Variables	**Intervention Group Short & Long Course N=30**	
Age per years Mean ±SD range	 51.0±4.6 43-62	
BMI Mean ±SD Range	 26.85±1. 53 23-29	
Gender n (%) Females Males	 7(23.3%) 23(76.7%)	
Smoking n (%) Current smoker Ex-smoker Non-smoker	 20(66.7%) 7(23.3%) 3 (10%)	
Dyspnea measured mMRC scale	No	%
Grade 2	16	53.4
Grade 3	10	33.3
Grade 4	4	13.3
Staging severity of COPD		
Grade 2	17	56.7
Grade 3	13	43.3

BMI: body mass index

Table (2): Effect of Pulmonary Rehabilitation program short versus long course on pulmonary function test among stable COPD patients

	Pre-	**PR short course N=30**	**PR long course N=30**	**Improvement %**	**Paired t**	**p**
FEV1/FVC(predicted %) Mean ±SD Range	59.9 ± 4.21 45-65	65.93±1.14 65-68	66.3±1.36 65-69	0.56	3.0	P1=0.001 P2=0.001 P3=0.005*
FEV1 (predicted %) Mean ±SD Range	56.2 ± 9.62 32-69	61.63± 5.19 50-69	62.4±4.46 55-69	0.02	2.51	P1=0.001 P2=0.001 P3= 0.018*
FVC (%) Mean ±SD Range	57.5 ± 1.54 55-60	59.63± 2.9 56-67	62.5±3.62 58-69	4.8	3.46	P1=0.02 P=0.005 P3=0.002*

Data were expressed Mean ±SD [SD=standard deviation], range, t =Student' t test, Paired t test; p≥0.05 was considered no significant, *p<0.05 was considered significant, P1: PR short versus Pre-readings; P2: PR long versus pre-readings , P3: PR short versus PR long

Table (3): Effect of Pulmonary Rehabilitation short program versus long program on among stable COPD patients

	Pre-	PR short course N=30	PR long course N=30	Improvement %	P
Oxygen saturation Mean ±SD Range	89.2 ± 1.69 86-94	91.8±1.86 88-96	94.36±1.49 92-97	2.8%	P1=0.02 P2=0.007 P3=0.0001 *

Data were expressed Mean ±SD [SD=standard deviation], range, t =Student' t test, Paired t test; p≥0.05 was considered no significant, *p<0.05 was considered significant, P1: PR short versus Prreadings; P2: PR long versus pre-readings , P3: PR short versus PR long

Table (4): Effect of Pulmonary Rehabilitation short program versus long program on mMRC, 6MWT

	Pre-	PR short course N=30	PR long course N=30	Improvement %	P
mMRC Mean ±SD Range	2.7 ± 0.53 2-4	2.1±0.57 1-3	1.60± 0.49 1-2	23.81%	P1=0.01 P2=0.009 P3=0.002
6MWD Mean ±SD Range	395.7 ± 47.6 300-480	409.5± 47.36 316-484	435.53±55.88 318-502	6.36%	P1=0.001 P2<0.001 P3=0.021

among stable COPD patients.

Data were expressed Mean ±SD [SD=standard deviation], range, t =Student' t test, Paired t test; p≥0.05 was considered no significant, *p<0.05 was considered significant, P1: PR short versus Pre-readings; P2: PR long versus pre-readings , P3: PR short versus PR long

Table (5): Effect of Pulmonary Rehabilitation short program versus long program Quality of life score among stable COPD

	Pre-	PR short course N=30	PR long course N=30	Improvement %	P
Quality of life score(VQ11) Mean ±SD range	4.47 ± 0.86 3-6	3.5±0.97 2-5	2.83±0.53 2-4	-19%	P1=0.002 P2=0.01 P3=0.004*

t =Student' t test, Paired t test; p≥0.05 was considered no significant, *p<0.05 was considered significant, P1: PR short versus Pre-readings; P2: PR long versus pre-readings , P3: PR short versus PR long

DISCUSSION

Chronic obstructive pulmonary disease (COPD) is known to be characterized by inflammation both in the stable phase of the disease and during exacerbation. In addition to local inflammation in the respiratory tract, pulmonary parenchyma and blood vessels of the lung, it has been shown that certain inflammatory mediators have a high level in systemic circulation, indicating systemic inflammation in COPD. The existence of systemic inflammation can be assessed by determining the levels of cytokines and acute phase reactants in the circulation, as well as the disorder of the number or function of inflammatory cells [7].

Chronic obstructive pulmonary disease (COPD) affects various structural and functional domains in the lungs. It also has significant extrapulmonary effects, the so-called systemic effects of COPD. Weight loss, nutritional abnormalities, and skeletal muscle dysfunction are well-recognized systemic effects of COPD. Other less well-known but potentially important systemic effects include an increased risk of cardiovascular disease and several neurologic and skeletal defects. The mechanisms underlying these systemic effects are unclear, but they are probably interrelated and multifactorial, including inactivity, systemic inflammation, tissue hypoxia and oxidative stress among others. These systemic effects add to the respiratory morbidity produced by the underlying pulmonary disease and should be considered in the clinical assessment as well as the treatment of affected patients [8].

Pulmonary rehabilitation (PR) programs are most often provided to stable patients or after discharge, and fewer training programs specific to acute exacerbation (AE) in unstable periods during hospitalization have been developed. Most studies that assessed the efficiency of PR during COPD have shown controversial results in hospitalized patients, who present more-severe exacerbation and/or more-severe underlying disease than stable COPD patients in an outpatient setting [9].

This study was carried out at Chest disease department at Pulmonary Rehabilitation Unit of Zagazig University Hospitals on 30 Stable COPD patients from July 2023 to February 2024 to evaluate the effect of Pulmonary rehabilitation (PR) program both short and long course among stable COPD patients to improve their tolerance and outcome. All patients were experienced program at 6 weeks and 12weeks. This study revealed that there is a significant improvement in pulmonary function tests for FEV1/FVC, FEV1 , FVC (prediction %) respectively, after long PR course compared to short PR course. Maestri et al., [10] concluded that there was a significant association with baseline FEV1/FVC, FVC, % predicted after long PR course compared to short PR course.

This study revealed that that there was significant improvement for oxygen saturation, after long PR compared to short PR program. In the same line Sahin et al., [11] in a study included 82 patients referred to hospital's PR Unit between June 2013 and June 2014, found that there was a significant improvement for oxygen saturation in long PR compared to short PR group. Also, Grosbois et al., [12] in a study administered to 211 patients with COPD (mean age, 62.3±11.1 years) concluded a similar results to the current results.

This study revealed that that there is a significant improvement in degree of dyspnea, moreover there is significant improvement in 6MWD, after long PR course compared to short PR course. Mkacher et al., [13] reported that the long PR group has significant improvements in the 6MWT distance and dyspnea, following long PR compared to short group.Also, our results was in accordance with Semary et al., [14] who found that Regarding the grade of dyspnea and capability of 6MW test; the present work reported that, before pulmonary rehabilitation program, the mean mMRC dyspnea scale of patients was 2.04 with a rang from (2-3) while the mean 6MWD was (410 m). They showed significant changes after the end of the program, as they recorded about 35% and 9% improvement for mMRC dyspnea scale and 6MWD respectively**.** Also in harmony with Xu et al., [15], they found that; exercise tolerance measured by 6MWT and dyspnea level determined through mMRC were significantly improved after 12 weeks of modified pulmonary rehabilitation.

This study revealed that there is a significant improvement in Quality of life score, after long PR course compared to short PR course. which in accordance with study of Gordon et al. [16] who concluded that PR is effective intervention to improve quality of life in people with stable COPD.

Yohannes et al. [17] demonstrates that QOL had significant improvements at 8 weeks of PR and were maintained at 2 years. Grosbois et al., [12] concluded that PR was associated with an improvement in exercise tolerance and in the quality of life of patients with severe asthma on a long-term basis.

Jácome & Marques [18] found that the overall findings suggest that long pulmonary rehabilitation program was effective in dyspnea improvement, tolerance of exercise and HRQOL in mild COPD patients.

Higashimoto et al., [19] concluded that continuous regular pulmonary rehabilitation training can improve lung function, quality of life, of stable COPD patients. The pulmonary ventilation function of the experimental group patients was obviously protected, and the 6MWT and CAT scores were obviously improved. In the control group, T cell function was also improved due to lifestyle changes such as smoking cessation.Berry et al. [20] conducted an study comparing a 3-month program versus 18 months. Patients in both programs achieved their greatest gains in self-reported disability and physical function at 3 months. However, patients in the longer program showed less disability and better physical function at 18 months. Sewell et al. [21] undertook an RCT in patients with COPD to assess whether a 4 weeks pulmonary rehabilitation program was equivalent to conventional 7 weeks pulmonary rehabilitation program. The authors found no important differences between the programs at 7 weeks and 6 months this may be contributed to the old age of their patients.

Programs with fewer than 2 weekly sessions sometimes, but not always, led to minimal improvement in health status and the 6-min walk test. Most programs that have shown benefit in clinical trial studies conducted more frequent training sessions. Thus, although the evidence is meager, one might expect patients to reach a plateau more rapidly with programs with greater frequency of training sessions.[22].

Pulmonary rehabilitation training is an important component in the treatment of COPD. At present, it mainly focuses on traditional abdominal breathing, pursed-lip breathing (PLB) training, abdominal breathing training, skeletal muscle training, and coughing expectoration training [23]. Pulmonary rehabilitation training reduces

respiratory exertion by training patients' coordinated movement of respiratory muscle groups, reducing muscle fixation and rigidity, improving exercise endurance and ability, and improving gas exchange efficiency [24].

Limitations : This study had certain limitations. The sample size of participated in the study and 6 months duration is not so long for such a chronic patient with prolonged progressive illness were insufficient for statistically conclusive results, therefore, the results cannot be generalized, Thus Future studies with larger population size and long period follow up in multicenter required to validate our results

CONCLUSIONS

Pulmonary Rehabilitation program should be conducted for all COPD patients, improving dyspnea, exercise tolerance and quality of life. For best results exercise should continued for long course of Pulmonary Rehabilitation.

Recommendation : We recommend doing further studies at longer follow-ups and larger number of patients in multi-center to confirm current finding and to provide further guidance about Pulmonary Rehabilitation in COPD patients with various severity of disease.

No Conflict of Interest
No financial disclosure

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Citation

Anwar, M., El-Shahat, H., Allali, A., Ibrahim, D. Evaluation of Short versus Long Course Pulmonary Rehabilitation Program among stable Chronic Obstructive Pulmonary Disease Patients. *Zagazig University Medical Journal*, 2024; (5126-5133): -. doi: 10.21608/zumj.2024.279601.3285