Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://dx.doi.org/10.21608/zumj.2020.28340.1825 Volume 28, Issue 6, November 2022(263-268) Supplement Issue

Manuscript ID ZUMJ-2004-1825 (R2)
DOI **10.21608/zumj.2020.28340.1825**

ORIGINAL ARTICLE

Outcome of Pulmonary Rehabilitation Among Patients with Stable Copd in Relation to Pulmonary Performance and Quality of Life.

Esraa A Semary[1], Ahmad Abbas[1], Amany Fawzy Morsy[1] and Mohammed Awad M Ibrahim[1]

1Chest diseases Department, Faculty of medicine Zagazig University, Egypt

Corresponding author
Esraa A Semary
chest diseases, Faculty of medicine Zagazig University, Egypt
E.mail :
dr.esraa.semary@gmail.com

Submit Date 2020-04-20
Revise Date 2020-05-18
Accept Date 2020-05-21

ABSTRACT

Background The response to pulmonary rehabilitation varied significantly among studies. **Aim** To evaluate the outcome of pulmonary rehabilitation among stable COPD patients and its impact on pulmonary performance and quality of life.

Methods Ninety stable COPD patients were included. Pulmonary functions and six minute walking test were assessed before and after 12 weeks rehabilitation program**.** Based on a decrease in SGRQ, the patients classified to failed and successful groups.

Results This work reported a 71.1%. prevalence of successful pulmonary rehabilitation among studied patients. The mean age of the studied patients was 61.9±4.7 years , 82.22% were males and 76.67%were smokers with mean BMI about 24 kg/m^2. Pulmonary Rehabilitation reported significant improvement of dyspnea scale by 35%, SGRQ by 10%, 6MWD by 9% and all spirometric pulmonary functions by up to 2%. The frequency of successful rehabilitation was significantly higher (100%) in mild and moderate (75.9%) groups of COPD, while failed outcome (55.17%) was significantly associated with severe degree of COPD, P = 0.03.

Conclusions The prevalence of successful pulmonary rehabilitation after short course program (12 week) were high (71.1%), the impact of pulmonary rehabilitation program was significant as regarding patient's pulmonary function, exercise performance and quality of life

Keywords: Pulmonary rehabilitation, COPD, pulmonary function, quality of life.

INTRODUCTION

Patients with chronic obstructive airway disease (COPD) had a significant air trapping that increased throughout the course of the disease and subsequently caused dynamic hyperinflation. The common clinical presentations from that group of patients were dyspnea and exercise intolerance.[1]

The cornerstone of non-pharmacological treatment of COPD is pulmonary rehabilitation , The role of pulmonary rehabilitation program in patients with COPD illustrated in many studies, it was not only enhancement of exercise performance status, but also extended to improvement of patients quality of life.[2]

The pulmonary rehabilitation showed a significant improvement in strength of inspiratory muscle and exercise capacity that leading to decrease of dyspnea. Furthermore, the diaphragmatic contraction power improved and overall pulmonary performance too.[3]

From that point of view, the current study designed to evaluate the outcome of pulmonary rehabilitation among stable COPD patients and its impact on pulmonary performance and quality of life.

PATIENTS AND METHODS

This study was carried out in Chest department, Zagazig University Hospitals from February 2019 to November 2019. Written informed consents were obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine,Zagazig University.The study was done according to The Code of Ethics of the world medical association (Declaration of Helsinki) for studies involving humans.

Ninety stable COPD patients were included. COPD was Diagnosed and classified according to gold 2019 [4]. They were Free from exacerbations 4 weeks before starting pulmonary rehabilitation.

All participants were subjected to the followings:

Full meticulous medical history taking and full clinical (general and local) examination. Degree of breathlessness related to activities was assessed by modified medical research council (mMRC) score[5]. Spirometric pulmonary function (Before and after rehabilitation). Six minute walking test (Before and after rehabilitation) [6].

Patients were undergone rehabilitation program for 12 weeks in the form of patient health education[4] and exercise training programs[7].

Various modes of training for both upper and lower limbs including endurance (aerobic), strengthing (resistance) exercises and breathing retraining technique according to (Spruit et al.,2013) [8].

Endurance training (cycle based vs. walking)

Cycle based using ergometer,walking based using treadmill and arm exercise using arm wheel

Continuous endurance training

The framework recommended by American college of sports medicine (ACSMs) guidelines for exercise testing and prescription on frequency, intensity, time and type (FITT). Frequency: 3 times/week. Intensity targets were 60-70% of maximum heart rate; HR max. (HR max= 220 - age), then it was increased gradually by 5-10% to reach 80-90% according to patients, ability to tolerate exercise.

Time of exercise was 10-15 minutes in 1st 3-4 sessions,then↑ progressively to 30-40 min. Type of exercise is continuous exercise

We monitored O2 saturation, heart rate, Borg dyspnea score and limb fatigue during every exercise training session.

Modified borg scale [9] used to assess the degree of breathlessness. This is a scale to rate the difficulty of breathing. It starts at number 0 where breathing is causing no difficulty at all and progresses through to 10 where breathing difficulty is maximum. End of exercise if Modified Borg scale >4-6 or Peak heart rate was reached

Interval endurance training: Alternative to continuous endurance training for patients who have difficulty in achieving their target intensity or duration because of dyspnea or fatigue. It is a modification of endurance training in which high intensity exercise is regularly interspersed with periods of rest.

Frequency is 3times/week. Intensity targets were 80-100% of maximum heart rate in the first 3-4 sessions, then it was increased gradually by 5-10% to reach 150% according to patients ,ability to tolerate exercise.

Type of exercise was interrupted with equal periods of rest and periods of exercise. Time is 30 second–180 second exercise with equal periods of rest.

Total time of exercise was 15-20 minutes in 1st 3-4 sessions, then ↑ progressively to 45-60 min (including resting time).

Monitoring and end of exercise same as continuous endurance training.

Strength training (resistance training): Free weights, Thera-Band and Ball exercise for both upper limb and lower limb according to American college of sports medicine [10] in the form of 2-4 sets of 6-12 repetitions should be under taken on 2-3 days/ week. End of exercise: Modified Borg scale >4-6 or muscle fatigue

Breathing exercises [11]

It included Pursed-lip breathing in which patient inhales through the nose with mouth closed, exhale through mouth lips pursed tightly. Exhalation was twice as long as inhalation. Also, diaphragmatic breathing in which patient inhales slowly through nose with abdomen expands outwards, exhale slowly through pursed lip while drawing abdomen inward.

Successful or failed rehabilitation: Based on SGRQ, the patients classified to failed and successful groups. The latter was defined as an improvement in quality of life as measured by a decrease of 4 points or more on the total SGRQ [12]

Statistical analysis

Continues data was represented as mean and slandered deviation (SD), while non numerical data as number and percentage (%).Paired t-test used to compare between one groups before and after treatment. Independent t-test: used to compare between two independent groups Person Chi square test: used to test the association between categorical variables.. All statistical tests were two sided, *P* considered significant if < 0.05.

RESULTS

The mean age of the studied patients was 61.9±4.7 years (ranged from 49 to 70 years) , 82.22% were males and 76.67%were smokers with mean BMI about 24 kg/m^2. Regarding COPD severity grades, 7.8% were mild ,32.2% were moderate and 60% were severe. The commonest comorbidities were HTN and DM (52.22% and 42.22% respectively). The lowest co-morbidity was thyroid disease (5.5%) ,**(Table 1 & Figure 1).**

This work reported a 71.1%. prevalence of successful pulmonary rehabilitation program among studied COPD patients

Before the rehabilitation program, mean FEV_1%, FVC% and FEV_1/FVC% were 60%, 59% and 59% of predicted value respectively .6MWD , So2%, total SGRQ were 410.34 , 92% ,43.25 respectively. Pulmonary Rehabilitation reported significant improvement of dyspnea scale by 35%, SGRQ by

10%, 6MWD by 9% and all spirometric pulmonary functions by up to 2%. **(Table 2)**

The frequency of successful rehabilitation was significantly higher (100%) in mild and moderate (75.9%) groups of COPD, while failed outcome (55.17%) was significantly associated with severe degree of COPD, P = 0.03.

Table 1. General characteristics of the studied population

Factors	Total (n = 90)		
	mean	**±**	**SD**
Age(years)	61.9	4.705	
	median	(Min-Max)	
	63	49-70	
Sex	N	%	
Female	16	17.78	
Male	74	82.22	
Smoking status	**N**	**%**	
Smoker	69	76.67	
EX-smoker	21	23.33	
Frequency of successful rehabilitation	64	71.1%	
	mean	**±**	**SD**
BMI(Kg/m^2)	23.844	3.298	
	median	(Min-Max)	
	24	20-29	

N: number, SD: standard deviation, Continuous data represented as mean and SD and categorical data as number and (%).

Table 2. Outcome of pulmonary rehabilitation :pulmonary performance and quality of life.

Variable	**Before (n=90)**		**After (n=90)**		**Mean change**	**Mean change %**	**P**
	(mean± SD)		(mean± SD)				
mMRC	2.04	0.72	1	0.66	1.06	35%	< 0.001
FEV1%	60%	15%	61%	15%	1%	1.6%	0.044
FVC %	59%	7%	60%	8%	1%	1.7%	0.041
FEV/FVC %	59%	7%	60%	8%	1%	1.7%	0.041
6MWD (m)	410.34	62.56	446.41	71.88	36.07	9%	< 0.001
SO2 %	92%	4%	94%	4%	2%	2%	0.031
TSGRQ	43.25	11.14	39.64	12.15	3.61	10%	< 0.001

n: number, SD: standard deviation.nMRC :modified Medical Research Council score, FEV1: forced expiratory volume in 1 second, FVC:forced vital capacity,6MWD:six minute walking distance,SO2: o2 saturation, TSGRQ: total St. George's Respiratory QuestionnaireContinuous data represented as mean and SD, $#: Paired t-test, P considered significant if < 0.05.

Table 3. The frequency of successful Pulmonary Rehabilitation in relation to COPD severity

Outcome	**Mild**	**Moderate**	**Severe**	**P**
	(n=7)	(n=54)	(n=29)	
Failed	0 (0%)	13 (24.07%)	13 (44.83%)	0.03#
Successful	7 (100%)	41 (75.93%)	16 (55.17%)	

N: number, categorical data represented as number and (%), #: chi square test, P considered significant if < 0.05

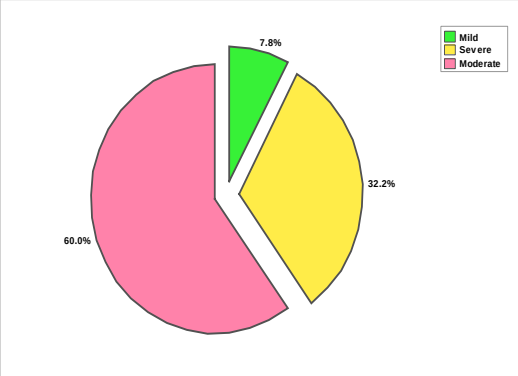

Figure 1. COPD severity grades among studied population

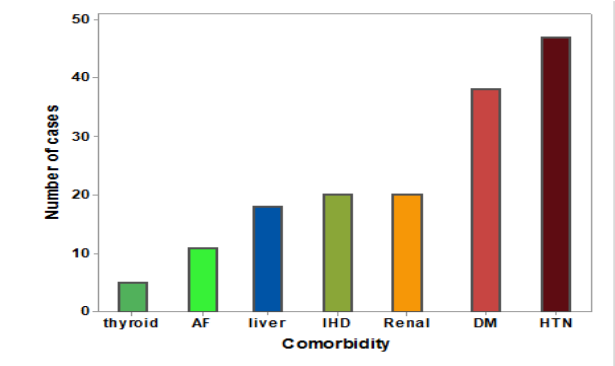

Figure 2. Co-morbidity profile among studied population

DISCUSSION

In the present study, the mean total SGRQ of COPD patients was 43.25 before pulmonary rehabilitation program and significantly lowered to 39.64 with significant improvement by 10% after pulmonary rehabilitation**.** Accordingly and depending on SGRQ changes limits, the prevalence of successful rehabilitation after 12 weeks of program was 71.1%.

Rate of successful rehabilitation varied between studies and ranged between 56 to 88%.[12-15]

There were many factors affecting the success of pulmonary rehabilitation program, the most important one is patient's compliance, poor social status as well as other psychological disabilities (depression and anxiety) and residences far from pulmonary rehabilitation program center. [16-18]

Considering the pulmonary function of patients at the baseline of rehabilitation program, the mean FEV_1%, FVC% and FEV_1/FVC were 60%, 59% and 59% of predicted respectively. They showed significant improvement after pulmonary rehabilitation; up to 2% change difference in FEV_1%, FVC% and FEV_1/FVC with mean value about 61%, 60% and 60% respectively.

In accordance with Crimi et al.[19], the changes in FEV_1%, FVC% and FEV_1/FVC were significant after 12 week of pulmonary rehabilitation program; they were 43%, 83% and 41% respectively opposite to 48%, 89% and 53% after pulmonary rehabilitation.

On the other hand,in chun et al.[20] ,the mean age of patients was 65 years; most of them were males with BMI 21Kg/m^2, the changes in pulmonary functions in COPD patients before and after pulmonary rehabilitation were insignificant, as in FVC % (P=0.137), FEV_1 % (P=0.297).

Some studies were not able to detect significant changes in spirometric values after pulmonary rehabilitation.[21,22] Thus, wide range of pulmonary rehabilitation outcomes depended on many factors, and referred directly to the policy of each rehabilitation center. Also, it might be related to difference in inclusion criteria and severity grades profile of the studied patients that varied between studies [23]

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**.**

This is in concordance with Crimi et al. [19], the median mMRC improved from 4 to 3, $P < 0.001$, and median 6MWD from 250 m to 300 m, $P < 0.001$.

Also in harmony with Xu et al.[24] , they found that; exercise tolerance measured by 6MWT and dyspnea level determined through mMRC were significantly

improved after 12 weeks of modified pulmonary rehabilitation.

Moreover, cheng et al.[25] observed significant improvements in maximal exercise performance after 12 weeks of exercise twice a week. In the same line, Sundararajan et al.[26] investigated the specific effect of a 6-week outpatient pulmonary rehabilitation program and found an improvement in walking distance, dyspnea score, and health status.

Many studies have shown that pulmonary rehabilitation reduces dyspnea on exertion, increases exercise capacity and improves health-related quality of life (QOL) in COPD patients. Moreover, they reported the effect of pulmonary rehabilitation program in improving the performance of skeletal and inspiratory muscle of patients with COPD and reported the benefits of that as dyspnea get better. [27-28]

To conclude, the prevalence of successful pulmonary rehabilitation after short course program (12 week) were high (71%), the impact of pulmonary rehabilitation program was significant as regarding patient's pulmonary function, exercise performance and quality of life.

REFERENCES

1. Theodorakopoulou EP, Gennimata SA, Harikiopoulou M, Kaltsakas G, Palamidas A, Koutsoukou A et al. Effect of pulmonary rehabilitation on tidal expiratory flow limitation at rest and during exercise in COPD patients. Respir Physiol Neurobiol.2017;238 :47-54.
2. Goldstein RS, Hill K, Brooks D,Dolmage TE. Pulmonary rehabilitation: a review of the recent literature. Chest.2012; 142(3):738-49.
3. Corbellini C, Boussuges A, Villafañe JH, Zocchi L. Diaphragmatic mobility loss in subjects with moderate to very severe COPD may improve after in-patient pulmonary rehabilitation. Respir care.2018; 63(10):1271-80.
4. Global initiative for chronic obstructive lung disease (GOLD) (2019): Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease, NHLBI/WHO workshop report.
5. Pasquale MK, Xu Y, Baker CL, Zou KH, Teeter JG, Renda AM et al. COPD exacerbations associated with the modified Medical Research Council scale and COPD assessment test among Humana Medicare members;Int J Chron Obstruct Pulmon Dis. 2016; 11: 111–121.
6. Dajczman E, Wardini R, Kasymjanova G, Préfontaine D, Baltzan MA, Wolkove N. Six minute walk distance is a predictor of survival in patients with chronic obstructive pulmonary disease undergoing pulmonary rehabilitation. Can Respir J.2015; 22(4): 225–229.
7. Nici L, Donner C, Wouters E, Zuwallack R, Ambrosino N, Bourbeau J, et al. American thoracic society/European respiratory society statement on pulmonary rehabilitation. Am J Respir Crit **Care** Med.2006;173(12):1390-413
8. Spruit M A , Singh S J , Garvey C, ZuWallack R, Nici L, Rochester C et al. An Official American Thoracic Society/European Respiratory Society Statement: Key Concepts and Advances in Pulmonary Rehabilitation. Am J Respir Crit **Care** Med.2013 ;1888(8):e13-e64.
9. Mahler DA, Horowitz MB. Perception of breathlessness during exercise in patients with respiratory disease. Med Sci Sports Exerc.1994; 26:1078–1081.
10. American College of Sports Medicine. American College of Sports Medicine position stand: progression models in resistance training for healthy adults. Med Sci Sports Exerc.2009;41:687–708.
11. Collins EG, Langbein WE, Fehr L, O'Connell S, Jelinek C, Hagarty E et al. Can ventilation feedback training augment exercise tolerance in patients with chronic obstructive pulmonary disease? Am J Respir Crit Care Med.2008;177:844–852.
12. Scott AS, Baltzan MA, Fox J, Wolkove N. Success in pulmonary rehabilitation in patients with chronic obstructive pulmonary disease. Can respir j.2010;17(5):219-23
13. Evans RA, Singh SJ, Collier R, Williams JE, Morgan MD. Pulmonary rehabilitation is successful for COPD irrespective of MRC dyspnoea grade. Respir Med.2009;103:1070-5.
14. Garrod R, Marshall J, Barley E, Jones PW. Predictors of success and failure in pulmonary rehabilitation. Eur Respir J.2006;27:788-94.
15. Vagaggini B, Costa F, Antonelli S, De Simone C, De Cusatis G, Martino F, Santerini S, et al. Clinical predictors of the efficacy of a pulmonary rehabilitation programme in patients with COPD. Respir Med.2009;103:1224-30.
16. Sabit R, Griffiths L, Watkins A, Evans W, Bolton CE, Shale DJ, et al. Predictors of poor attendance at an out-patient pulmonary rehabilitation programme. Respir Med.2008;102:819-24.
17. Fan VS, Giardino ND, Blough DK, Kaplan RM, Ramsey SD, NETT Research Group. Costs of pulmonary rehabilitation and predictors of adherence in the National Emphysema Treatment Trial. COPD.2008;5:105-16.
18. Reardon J, Casaburi R, Morgan M,Nici L,Rochester C et al. Pulmonary rehabilitation for COPD. Respir Med.2005;99:S19-27.
19. Crimi C, Heffler E, Augelletti T, Campisi R, Noto A, Vancheri C, Crimi N. Utility of

ultrasound assessment of diaphragmatic function before and after pulmonary rehabilitation in COPD patients. Int J Chron Obstruct Pulmon Dis. 2018; 13: 3131–3139.
20. Chun EM, Han SJ, Modi HN. Analysis of diaphragmatic movement before and after pulmonary rehabilitation using fluoroscopy imaging in patients with COPD. Int J Chron Obstruct Pulmon Dis.2015;10:193.
21. Vogiatzis I, Williamson AF, Miles J, Taylor IK. Physiological response to moderate exercise workloads in a pulmonary rehabilitation program in patients with varying degrees of airflow obstruction. Chest.1999;116(5):1200–1207.
22. Karapolat H, Atasever A, Atamaz F, Kirazli Y, Elmas F, Erdinç E. Do the benefits gained using a short-term pulmonary rehabilitation program remain in COPD patients after participation? Lung.2007;185(4):221–225.
23. Moore E, Newson R, Joshi M, Palmer T, Rothnie KJ, Singh S, et al. Effects of pulmonary rehabilitation on exacerbation number and severity in people with COPD: an historical cohort study using electronic health records. Chest. 2017;152(6):1188-202.
24. Xu J, He S, Han Y, Pan J, Cao L. Effects of modified pulmonary rehabilitation on patients with moderate to severe chronic obstructive pulmonary disease: A randomized controlled trail.Int JNurs Sci.2017; 10;4(3):219-24.
25. Cheng ST, Wu YK, Yang MC, Huang CY, Huang HC, Chu WH, Lan CC. Pulmonary rehabilitation improves heart rate variability at peak exercise, exercise capacity and health-related quality of life in chronic obstructive pulmonary disease. Heart & Lung: **Acute** Crit **Care**. 2014;43(3):249-55.
26. Sundararajan L, Balami J, Packham S. Effectiveness of outpatient pulmonary rehabilitation in elderly patients with chronic obstructive pulmonary disease. J Cardiopulm Rehabil Prev.2010;30(2):121-5.
27. Sala E, Roca J, Marrades RM, Alonso J, GONZALEZ de SUSO JM, Moreno A et al. Effects of endurance training on skeletal muscle bioenergetics in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1999;159(6):1726–1734.
28. Gigliotti F, Coli C, Bianchi R, Romagnoli I, Lanini B, Binazzi B, Scano G. Exercise training improves exertional dyspnea in patients with COPD: evidence of the role of mechanical factors. Chest.2003;123(6):1794–1802.

How to cite
Semary, E., Abbas, A., Fawzy, A., Awad, M. Outcome of pulmonary rehabilitation among patients with stable COPD in relation to pulmonary performance and quality of life. Zagazig University Medical Journal, 2022; (263-268): -. doi: 10.21608/zumj.2020.28340.1825