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Estimating the Effectiveness of Pulmonary Rehabilitation in Patients with Chronic Obstructive Lung Disease

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Abstract:

Chronic obstructive pulmonary disease (COPD) is a progressive and irreversible airflow limitation with inflammatory response of the lung and airways. COPD is a preventable and treatable disease with some significant extra-pulmonary effects that may contribute to the severity and progress of the disease. Pulmonary Rehabilitation is multidisciplinary intervention helps in improvement of symptoms, decrease of breathlessness, and improves the quality of life. The aim of this study is to estimate and evaluate the effectiveness of PR program in COPD patients. In this study regarding Pulmonary Function Test, there was no statistical significant difference in FEV1 pre and post Rehabilitation, but there was statistical significant difference in (FEV1%F, FVC and FEF) pre and post Rehabilitation. Regarding arterial blood gases there was statistical significant difference in (PH, Pao2 and O2 mood) ,but there was no statistical significant difference in (Paco2 and Hco3) pre and post Rehabilitation . Regarding 6MWT there was statistical significant difference pre and post Rehabilitation and finally regarding mMRC dysnea scale there was statistical significant difference pre and post Rehabilitation.

Keywords: COPD risk factors - COPD systemic features -Skeletal muscle dysfunction -Pulmonary Rehabilitation Program.

1. Introduction

Chronic obstructive pulmonary disease (COPD) influences different areas of lung structure and capacity, leading to airflow limitation. The so-called systemic effects of COPD occur due to its significant effect in distant organs outside the lungs [1]. The

airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles and gases .The chronic airflow limitation characteristic of COPD is caused by mixture of small airway disease (obstructive bronchiolitis) and parenchymal destruction (emphysema), the relative contribution of which vary from person to person [2]. For prevention and proper management of COPD it's important to identify COPD risk factors . COPD has A variety of Risk factors the most common is Tobacco smoking , indoor and our pollution , occupitional pollution and Infection [3].

Pulmonary Rehabilitation is multidisciplinary intervention that helps in decrease exercise intolerance, increase functional incapacity, improvement of symptoms, relieve of breathlessness and improve quality of life. PR program is widely used and vary in length and components from one center to the other, but still the main components are exercise training, education, nutritional support, psychological support . It also differ in lenght of the program from (6-8) weeks [4]. PR program is perceeded by pre-assessment program in which the chest physician takes detailed medical history from the patient , examine and investigate the patient to evaluate his condition . The Pre assessment program should also done during and at the end of the program the physician leads and coordinate the team while the role of Chest physiotherapy is non- essential he help to evacuate secretion in severe cases [5]. PR program is followed by maintenance program for better results.

2. Subject and Methods:

This study included 60 stable COPD patient (44 male and 16 female) who were recruited from outpatient clinic of Beni-Seuf University hospital and general chest hospital in Beni-Seuf , the study has been done from December 2017 to September 2018.

2.1 Inclusion criteria:

1- All patients will fulfill the criteria of COPD according to GOLD.

2- Patient with COPD who wants to improve exercise capacity.

3- Patient with COPD who wants to improve his psycological wellbeing.

4- Patient wants to cessate smoking.

5- Patient wants to improve his health state and decrease symptoms.

All COPD patients were submitted to:

2.2. Detailed history taking stressing on: Smoking history, occupational history, history of indoor pollution , history of symptoms include cough ,expectoration, dysnea and wheeze.

2.3 Clinical examination:

A- General examination Including : Head and Neck examination, Upper and lower limb examination, Cardiovascular system examination and Abdominal examination.

B-Local examination including: Inspection, Palpation, Percussion and Auscultation.

2.4 Investigation :

A- Laboratory: ABG , CBC , kidney and liver functions, lipid profile Fasting & 2 hours post prandial blood glucose.

B- Radiological: including X-ray.

2.5 Pulmonary Function Test.

2.6 Six-Minute Walk Test.

2.7 Pulmonary Rehabilitation Program including:

A- Exercise training including : Strenthening training , breathing training.

B- Patient Health Education .

C- Nutritional Intervention .

3. Results:

This study included 60 stable COPD patient (44 male and 16 female) who were recruited from outpatient clinic of Beni Suef University hospital and chest hospital in Beni Suef , the study has been done from December 2017 to September 2018 .

Table (1) demonstrates PH before and after Pulmonary Rehabilitation.

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.001*[1]
PH	7.28	7.51	7.40 ±0.1	7.36	7.54	7.43 ±0.04	

There was statistical significant difference in PH, Mean ±SD before was 7.40 ±0.1 which become 7.43 ±0.04 after Pulmonary Rehabilitation.

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Table (2) demonstrates PO2 before and after Pulmonary Rehabilitation

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.001*[1]
PO2	44.40	82.50	53.09 ±12.3	51.70	93.20	67.28 ±11.7	

There was statistical significant difference before and after Rehabilitation ; Mean ±SD was 53.09 ±12.3 which become 67.28 ±11.7 after Pulmonary Rehabilitation

Table (3) Comparison of PCO2 before and after Pulmonary Rehabilitation :

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.052[1]
PCO2	26	80.90	55.36 ±11.0	34	73.30	53.03 ±9.6	

There was statistical significant difference in (FVC) before and after pulmonary Rehabilitation.

Table (4) Comparison of HCO3 before and after Pulmonary :

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.409[1]

HCO3	18.40	52.10	31.21 ±5.3	25	40.50	31.80 ±4.5	

There was no statistical significant difference before and after Pulmonary Rehabilitation.

Table (5) Comparison of SO2 before and after Pulmonary Rehabilitation :

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.001*[1]
SO2	50	96	15.50 ±10.5	59	99	92.30 ±5.7	

There was statistical significant difference before and after Rehabilitation ; Mean ±SD was 15.50 ±10.5 before Rehabilitation which 92.30 ±5.7 after Rehabilitation.

Table (6) Comparison of FVC before and after Pulmonary Rehabilitation :

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.001*[1]
FVC	12	66.7	62.35 ±846.3	29	89.80	56.62 ±14.6	

There was statistical significant difference in (FVC) before and after pulmonary Rehabilitation .

Table (7) Comparison of FEV1 before and after Pulmonary Rehabilitation in COPD patients ; (N=60):

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			***p-value***
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.336(1)
FEV1	9.30	79	36.87 ±22.5	10.90	72	40.08 ±23.2	

There was no statistical significant difference in (FEV1) before and after Pulmonary Rehabilitation

Table (8) Comparison of FEV1 %F before and after Pulmonary Rehabilitation in COPD patients ; (N=60):

	Before Pulmonary Rehabilitation			After Pulmonary Rehabilitation			*p-value*
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.001*1
FEV1%F	19.26	69	47.25 ±15.2	19.38	64	49.26 ±16.3	

There was statistical significant difference in FEV%F before and after Pulmonary Rehabilitation . Mean ±SD was 47.25 ±15.2 before Rehabilitation which become 49.26 ±16.3after rehabilitation.

Table (9) Comparison of 6 minute walking Test (6MWT) before and after Pulmonary Rehabilitation in COPD patients ; (N=60):

	Before Pulmonary Rehabilitation	After Pulmonary Rehabilitation	*p-value*

	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD	0.001*[1]
6MWT	124	419	207.58 ±78.8	170	488	351.35 ±80.7	

There was statistical significant difference in 6MWT results before and after Rehabilitation Exercises; Mean ±SD was 207.58 ±78.8 which become 351.35 ±80.7 after Rehabilitation.

Table (10) Modified Medical Research Council (mMRC) dyspnea scale before and after Pulmonary Rehabilitation in Patients with Chronic Obstructive Pulmonary Disease

	Before Pulmonary Rehabilitation	After Pulmonary Rehabilitation	P-value
MRC Dyspnea Scale; n (%)			0.001*[2]
Grade (0)	5 (8.3)	31 (51.7)	
Grade (1)	13 (21.7)	20 (33.3)	
Grade (2)	15 (25.0)	2 (3.3)	
Grade (3)	19 (31.7)	7 (11.7)	
Grade (4)	8 (13.3)	0 (0.00)	

There was statistical significant difference in dyspnea before and after Rehabilitation Dyspnea improved after exercise according to MRC dyspnea scale

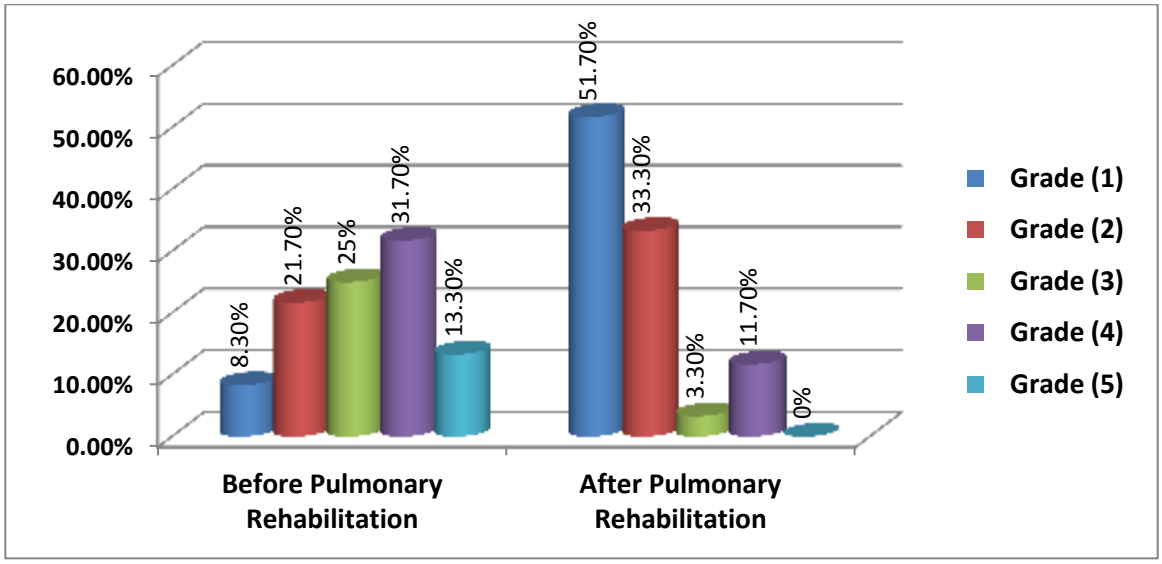

Figure (1): modified Medical Research Council (mMRC) dyspnea scale before and after Pulmonary Rehabilitation in Patients with Chronic Obstructive Pulmonary Disease

4. Discussion :

COPD is characterized by poorly reversible airflow limitation and dyspnea [7] **,** while the disease progresses , systemic manifestations develop in some patients such as exercise limitation , peripheral muscle dysfunction and frequent hospitalizations owing to recurrent exacerbations[8] COPD is considered to have poor response to treatment as most therapies have minimal effect on the impaired lung function [9].

Pulmonary Rehabilitation is a treatment option that does not improve pulmonary function but has great effects on some disease consequences. PR decrease the burden of healthcare resource utilization, enhances health status [10] , decrease dyspnea and improves exercise capacity [11]. In the present study we aimed at evaluating the effectiveness of 6 weeks of outpatient PR on improving breathlessness , quality of life ,exercise tolerance and functional ability in patients with stable COPD. In this study as regard Pulmonary Function Test , there were no statistical significant difference in FEV1 pre and post Rehabilitation , mean FEV1was(36.87 ±22.5) before PR which become (40.08 ±23.2) after Rehabilitation. FEV1comparison pre and post Rehabilitation also show that number of moderate cases pre rehabilitation were 10 which become 16 post Rehabilitation , N. of severe cases pre Rehabilitation were 22

which become 21 while N. of very severe cases pre Rehabilitation were 28 which become 23 post Rehabilitation**.** But regarding FEV1%F there were statistical significant difference pre and post Rehabilitation , mean FEV1%F was(47.25 ±15.2) which become (49.26 ±16.3) after Rehabilitation. Regarding FVC there were statistical significant difference pre and post Rehabilitation ,mean FVC was (62.35 ±846.3) which become (56.62 ±14.6) after Rehabilitation .Also regarding FEF there were statistical significant difference pre and post Rehabilitation mean was (9.58 ±5.1) pre PR which become (13.87 ±6.4) post Rehabilitation . [12] found that there were no statistical significant difference in FEV1, FVC, FEV1/FVC after 12 weeks of PR , On the contrary [13] found that FEV1 slightly improved in CRF group by approximately 112 ml increase versus 154 ml in non-CRF group (p=0.03 between groups, p=0.001 vs. baseline) this improvement may be due to large cohort (1047 COPD patients). Patients were subjected to comprehensive PR program (patient education , exercise training , nutrition and psychological support). [7] stated that PR should be applied for patients with COPD complaining of symptoms and having FEV1 below 80% , while [14] performed PR to patients with COPD with different severity stages can benefit from PR irrespective of disease severity. [15] also demonstrated that PR for patients with COPD was beneficial in severity stages (stage I and II) as wee as stage III and IV.In this study regarding ABG ,there were statistical significant difference in PH before and after Rehabilitation , mean PH was(7.40 ±0.1) and (7.43 ±0.04)) pre and post PR respectively. There were also statistical significant difference in Pao2 , mean Pao2 before PR was (53.09 ±12.3)which become (67.28 ±11.7) after PR , while regarding Paco2 there were no statistical significant difference before and after PR , mean Paco2 was (55.36 ±11.0) and (53.03 ±9.6) pre and post PR respectively . Regarding HCO3 there were no statistical significant difference before and after Rehabilitation , mean Hco3 was (31.21 ±5.3) which become (31.80 ±4.5) after PR. Regarding So2 there were statistical significant difference pre and post PR , mean So2 was (15.50 ±10.5) and (92.30 ±5.7) pre and post PR respectively. Regarding O2 mood there were statistical significant difference before and after PR number of patients on

RA : was 24 and 33 , N. of patients on 0.5L was 2 and 12 N. of patients on 1L was 13 and 9 , N. of patients 1.5L was 1 and 0, N. of patients on 2L was 13 and 4 , N. of patients on 3L was 5 and 2 while N. of patients on 4L was 2 and 0 before and after PR respectively . [16] stated that after 8- weeks training ABGs were not affected by period of training

in either groups. The 6MWT measures the global and integrated responses of most body systems included during exercise such as pulmonary and cardiovascular system , peripheral and systemic circulation , blood and neuromuscular system . The 6MWT is a valuable parameter to evaluate exercise capacity in COPD patient [17].

In this study there were statistical significant increase in 6MWT before and after PR. Mean ±SD was (207.58 ±78.8) before PR which become (351.35 ±80.7) after Rehabilitation [18] compared the difference in the mean change in 6MWT distance from baseline to follow up between PR and usual care groups and there was statistical significant improvement in functional exercise capacity for PR group compared to usual care group ($p<0.05$). [19] also showed that there were statistical significant difference in exercise capacity in PR group compared to usual care group . [16] concluded that exercise capacity in moderate and severe COPD was significantly increased by 8- week training program which consists of two sessions a week ,when intensive endurance training was involved in the program , the exercise response was not affected by disease severity , but this improvement was transient and exercise capacity was declined again to baselines 6 months after training . On the contrary , [13] found non-significant improvement in 6MWT among both groups in 48.2 m in chronic respiratory failure (CRF) group and 47.8 m in Non chronic respiratory failure (non-CRF) group ($p>0.05$). close adherence to the Rehabilitation program may be one of the causes of improvement noticed in both patients groups, moreover the improvement in CRF patients denoted that the exercise capacity can be alleviated also in patients with severe COPD. [20] showed that Rehabilitation program with more frequent sessions are more effective than program with less frequent sessions (34.5 m with <28 session vs. 50.3 m with >28 session) . Regarding Dyspnea improvement among studied patients there were statistical significant decrease in dyspnea mMRC dyspnea scale before and after PR . Dyspnea improved after exercise training according to mMRC scale , number of patients in grade (4) =8 before Rehabilitation had become = 0 after Rehabilitation, N. of patients in grade (3) = 19 before Rehabilitation had become =7 after Rehabilitation , N. of patients in grade (2) = 15 before Rehabilitation had become= 5 after Rehabilitation, N. of patients in grade (1) = 13 before rehabilitation had become= 20 after Rehabilitation ,while N. of patients in grade (0) = become = 31 after Rehabilitation .[20] concluded that PR improves dyspnea and fatigue , relieves emotional disturbances and enhances exercise endurance.

5. Conclusion and Recommendation:

- Pulmonary Rehabilitation program should be conducted for all COPD patients , it help in reduction of exacerbations and reduction in the use of the health care system.
- Pulmonary Rehabilitation Program could be applied to stable COPD patient or after COPD exacerbation.
- Moderate , severe and very severe COPD patients benefit more from Pulmonary Rehabilitation program.
- Smoking Cessation patients can also benefit from PR program.
- For best results exercise should consist of 3 session per week for 3 months.
- For best results maintenance program should be followed by COPD patient.
- All patients should receive disease education to improve their compliance with medication regimens, oxygen therapy, nutritional interventions and exercise which contribute to the overall autonomy of the patient.
- optimal nutritional status help to improve the patient's state of health, sense of wellbeing and respiratory muscle function.

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