

# Role of Inpatient Pulmonary Rehabilitation Program in Acute Exacerbation of Chronic Obstructive Pulmonary Disease Patients: A Case Series

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**Abstract:** *Chronic Obstructive Pulmonary Disease (COPD) defined as a chronic inflammatory lung disease that causes airflow obstruction and limitation of the lungs that primarily affects the airway and lung parenchyma. Pulmonary rehabilitation (PR) in COPD have been shown improvement of respiratory capacity, exercise capacity, self-efficacy, quality of life, and reduce COPD-related hospital admission. The purpose of postural drainage, manual technique, and cough control is to drain the excessive sputum, while breathing control with pursed-lip breathing and breathing exercise with deep breathing exercise and chest expansion exercise are to improve the respiratory capacity and control. The purpose of this study was to investigate the feasibility and outcome of PR in patients with Acute Exacerbation (AE) of COPD. This case report describes 4 patients with of AE of COPD who received PR. The inpatient PR program was 5 consecutive days twice daily of 3 times repetition cough control, 2 sets of 6 repetition pursed lip breathing, 2 sets of 6 repetition deep breathing exercise, postural drainage, and manual clapping. The postural drainage and the manual technique were given according to the chest x-ray result. The result of 5 days PR was: improvement of clean airway, SOB, incentive spirometer, chest expansion, and single breath count test in all subjects. Our findings demonstrate that early inpatient PR in COPD AE is safe, significantly effective and beneficial by improving many aspects of respiratory function.*

**Keywords:** *Chronic Obstructive Pulmonary Disease, Pulmonary Rehabilitation.*

## I. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is one of the obstructive lung diseases characterized by a reduction in

airflow and airflow limitation [1]. COPD is the most common type of lung disease and the third leading cause of chronic morbidity and mortality in the United States and worldwide, which is primarily attributable to its link with smoking [2,3].

Treatment of pulmonary disease involves a multipronged approach to achieve maximum benefit, which includes optimization of medical management, chest physical therapy, exercise training, oxygen therapy, and nutritional and psychosocial support [1]. Pulmonary rehabilitation (PR) for patients with COPD aims to improve disease management and exercise capacity [1,4]. In addition, pulmonary rehabilitation improves symptoms, respiratory capacity, physical and emotional participation, and quality of life of COPD patients [4].

Pulmonary rehabilitation is supported by the highest evidence level. A systematic review with meta-analyses by Rughjerg et al [5] showed that significant improvement in short-term Health Related Quality of Life (HRQoL) following PR in mild symptoms COPD patients. Pulmonary rehabilitation is one of important components of the management of COPD and proven to be beneficial in improving the quality of life of COPD patients [6]. Another study by He et al [7] showed that PR is safe and feasible to implement as an early inpatient pulmonary rehabilitation program with acute exacerbation of COPD.

This case series was conducted to determine whether early pulmonary rehabilitation in COPD patient at inpatient setting following acute exacerbation is effective in improving pulmonary function capacities and quality of life.

## II. MATERIALS AND METHODS

3 patients were recruited from July - September 2019. This case series used mixed methods of quantitative outcome assessment and also qualitative interviews. The inpatient pulmonary rehabilitation program consisting of 5 consecutive days supervised private sessions twice daily. The program included 3 times repetition cough control, 2 sets of 6 repetition pursed lip breathing, 2 sets of 6 repetition deep breathing exercise, postural drainage, and manual clapping. The postural drainage and the manual clapping were chosen according to the CXR.

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This case series was subsequently approved and registered at Ethical Committee of RSUD Dr. Saiful Anwar Malang.

Patients agreed to gave written informed consent to participate in the study at the first visit.

### III. CASE PRESENTATION

#### A. Case 1

A 43-year-old male patient consulted by Pulmonology Ward at 1<sup>st</sup> day of hospitalization with acute exacerbation COPD, inactive lung tuberculosis, and pneumonia. Patient complained of shortness of breath, high fever, and productive cough. At initial visit, the results of patient's assessment were as followed: pulmonary function capacities assessment showed inspiration capacity with incentive spirometry 675 cc/s; chest expansion 1,8 cm; Single-Breath Counting (SBC) 35; CXR results show infiltrate at apex on right and left upper lobe which indicate lung tuberculosis.

After 5 days of pulmonary rehabilitation, the examination results showed that there were clean airway, improvement of SOB, incentive spirometry was 1200 cc/s, chest expansion 3,3 cm, and SBC 30. The spirometry results on the day 5 showed force vital capacity (FVC) 65,1 %, forced expiratory volume in 1 second (FEV1) 30,3 %, and FEV1/FVC ratio 38,97 % with conclusion mild restriction and moderate obstruction.

#### B. Case 2

A 47-year-old male patient consulted by Pulmonology Ward at 1<sup>st</sup> day of hospitalization with acute exacerbation COPD and pneumonia. Patient complained of shortness of breath, high fever, and productive cough. At initial visit, the results of patient's assessment were as followed: pulmonary

function capacities assessment showed inspiration capacity with incentive spirometry 900 cc/s; chest expansion 1 cm; Single-Breath Counting (SBC) 8; CXR results show infiltrate at lower right lobe which indicated COPD and pneumonia.

After 5 days of pulmonary rehabilitation, the examination results showed that there were clean airway, improvement of SOB, incentive spirometry was 1200 cc/s, chest expansion 3 cm, and SBC 21. The spirometry results on the day 5 showed FVC 72 %, FEV1 64,7 %, and FEV1/FVC ratio 74,64 % with conclusion mild restriction and mild obstruction.

#### C. Case 3

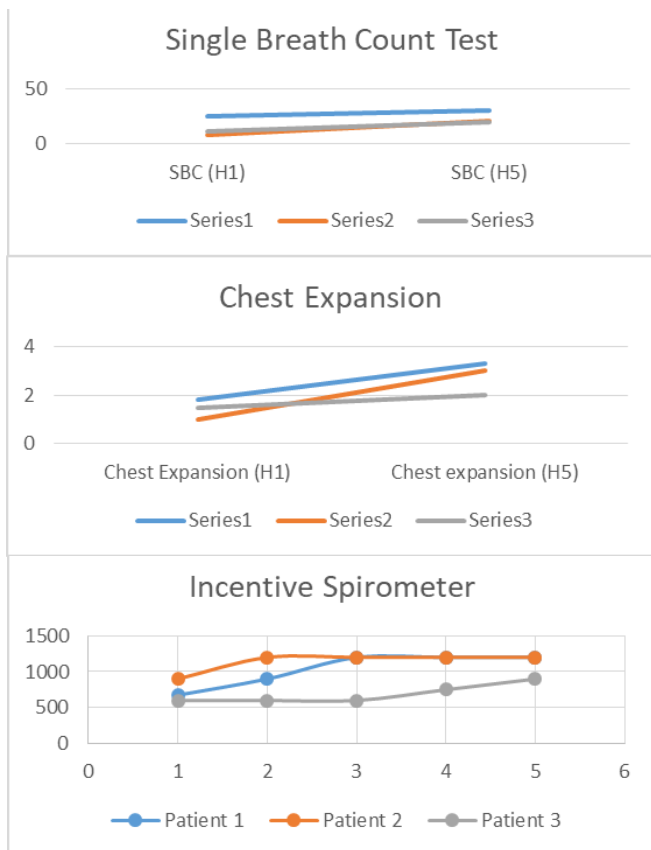
A 60-year-old male patient consulted by Pulmonology Ward at 1<sup>st</sup> day of hospitalization with acute exacerbation COPD and pneumonia. Patient complained of shortness of breath, high fever, and productive cough. At initial visit, the results of patient's assessment were as followed: pulmonary function capacities assessment showed inspiration capacity with incentive spirometry 600 cc/s; chest expansion 1,5 cm; Single-Breath Counting (SBC) 11; ADL by Barthel Index was 70; CXR results show COPD and pneumonia at right lower lobe.

After 5 days of pulmonary rehabilitation, the examination results showed that there were clean airway, improvement of SOB, incentive spirometry was 900 cc/s, chest expansion 2 cm, SBC 20, and Barthel Index 100. The spirometry results on the day 5 showed FVC 47,5 %, FEV1 47.7 %, and FEV1/FVC ratio 100 % with conclusion moderate restriction.

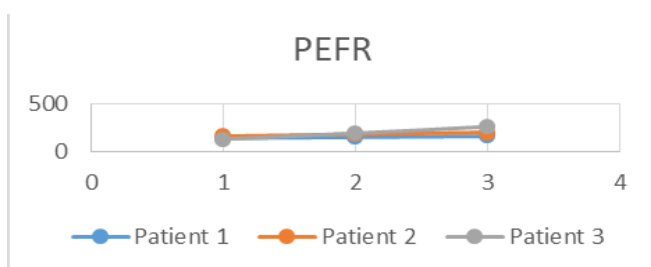
**TABLE-1: RESULT OF PULMONARY FUNCTION TEST AND QUALITY OF LIFE ASSESSMENT BEFORE AND AFTER INPATIENT PULMONARY REHABILITATION PROGRAM IN PATIENTS FOLLOWING ACUTE EXACERBATION OF COPD**

Indicator	Patient 1	Patient 2	Patient 3
<b>Incentive Spirometer</b>			
Incentive spirometer (H1)	675	900	600
Incentive spirometer (H2)	900	1200	600
Incentive spirometer (H3)	1200	1200	600
Incentive spirometer (H4)	1200	1200	750
Incentive spirometer (H5)	1200	1200	900
<b>Chest Expansion</b>			
Chest Expansion (H1)	1,8	1	1,5
Chest expansion (H5)	3,3	3	2
<b>Single Breath Count (SBC)</b>			
SBC (H1)	25	8	11
SBC (H5)	30	21	20
Insp (H1)	41	41	27
Exp (H1)	18	20	18
Pefr (H1)	140	160	130
Insp (H3)	41	41	35
Exp (H3)	20	20	20
Pefr (H3)	150	180	190

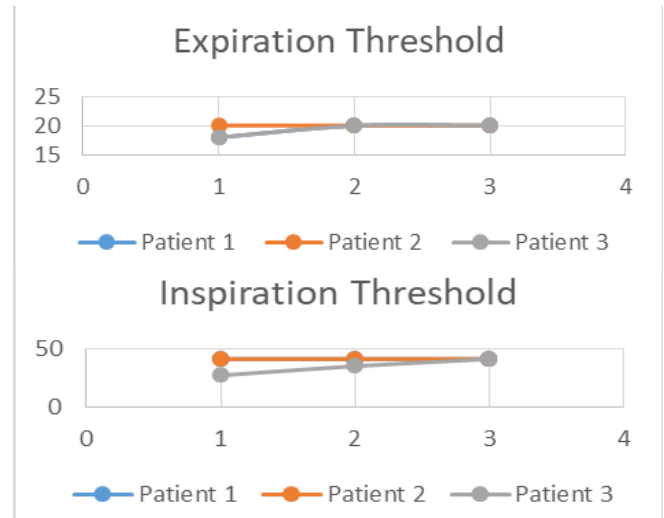
Insp (H5)	41	41	41
Exp (H5)	20	20	20
Pefr (H5)	160	200	260
<b>Spirometry at Day 5</b>			
FVC (%)	65,1	72	47,5
FEV1 (%)	30,3	64,7	47,7
FEV1/FVC (%)	38,97	74,64	100
Result	mild restriction and moderate obstruction.	mild restriction and mild obstruction.	restriction.



**Fig. 1. Fig.1. Result of pulmonary function test including incentive spirometer, chest expansion, and single breath count test assessment before and after inpatient pulmonary rehabilitation program in patients following acute exacerbation of COPD.**



**Fig. 2. Fig.2. Result Peak Expiratory Flow Rate (PEFR) assessment before and after inpatient pulmonary rehabilitation program in patients following acute exacerbation of COPD.**



**Fig. 3. Fig.3. Result inspiration and expiration threshold assessment before and after pulmonary rehabilitation program in a patient following acute exacerbation of COPD**

#### IV. DISCUSSION

The concepts of COPD rehabilitation has several complex and multimodal components consist of treatment optimization, education & instruction, smoking cessation, exercise training & breathing retraining, exacerbation management, and non-invasive ventilation [8]. Evidence based of pulmonary rehabilitation is supported by highest level evidence (A and B level). Pulmonary rehabilitation had A level evidence for improving quality of life, general physical performance ability, strength & muscle mass, and reduction in resting and exertional dyspnea [4,8]. It is had B level evidence for reduction the hospital admissions and days spent in hospital also decrease in COPD associated anxiety and depression [4,8].

There are several guideline in treating COPD. Our inpatient pulmonary rehabilitation programs are in line with the recommendation by The Global Initiative for Chronic Obstructive Lung Disease (GOLD) and American thoracic Society/European Respiratory Society (ATS/ERS) policy statement. The guidelines mention that COPD is a preventable and treatable lung disease that has several symptoms such as dyspnea, cough, sputum production, and also association with recurrent lower respiratory tract infection [4,9]. There is no difference of treatment management in the guidelines. The guidelines mention the treatments management of COPD are pharmacological with medication, smoking cessation, and also the



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pulmonary rehabilitation [4,9].

Puhan et al [10] found that PR in acute exacerbation of COPD is clinically safe and beneficial in improving patient's exercise capacity and quality of life.

The goals of pulmonary rehabilitation are to reduced hospitalization and unscheduled healthcare visits, improve exercise capacity, reduce symptoms, improve muscle strength and endurance, quality of life, functional capacity, and also emotional function [4,9]. In this study, we found that pulmonary program can reduce the dyspnea, drain the excessive sputum, also improve the respiratory functions, which all above are improve the quality of life.

Eaton et al [11] found that early inpatient-outpatient pulmonary rehabilitation was feasible and safe in a randomized controlled study in 97 elderly patients hospitalized with COPD exacerbation. The pulmonary rehabilitation was associated with a non-significant trend in reducing COPD-related re-hospitalization and length of stays. There were no side effect finding of pulmonary rehabilitation in acute exacerbation of COPD, so pulmonary rehabilitation was estimated safe.

Study of Jette et al [12] in 64-year-old woman taking part in pulmonary rehabilitation program in outpatient care after 3 COPD exacerbations over 4-months period has similar results with this study. There were clinically significant improvements shown in patient's quality of life as well as exercise capacity.

Although there were improvement of symptoms and respiratory functions in acute exacerbation COPD patients with our pulmonary rehabilitation program, our study has several limitation. First, this study has limited patient and there is no follow-up data of post hospitalization. Second, this study use simple measurements as the indicators of respiratory function, but still, there are more complete measurement that can be used for respiratory function evaluation. However, this also a benefit that this method only need simple measurements that can be done at all health facilities. Further larger study is needed to evaluate the optimal effectiveness of this method, including long-term follow-up data and more complete measurement.

## V. CONCLUSION

Early inpatient pulmonary rehabilitation programs give benefit by reducing symptoms and improving many aspects of respiratory function in acute exacerbation of COPD hospitalized patient. Pulmonary rehabilitation program in this study aims to improve airway cleaning, control breathing and cough, and strengthen respiratory muscles that lead to improve patient's respiratory function capacities.

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