ORIGINAL ARTICLE

Improvement of the Functional Parameter in Patient with Chronic Obstructive Pulmonary Disease after Pulmonary Rehabilitation

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ABSTRACT

Background: Functional parameter in Chronic Obstructive Pulmonary Disease (COPD) can be evaluated with Peak Cough Flow (PCF), as an effective tool to measure cough ability. Patients with COPD can not do cough effectively, that leads to sputum retention and finally functional capacity. The aimed of the study to found improvement of cough ability (PCF) and COPD symptom.

Methods: This was a retrospective cohort study. The researcher did the measurement for PCF, COPD assesment tool (CATTM) score and the sixt minute walking test (6MWT) on COPD patients, after rehabilitation program three times a week, for four weeks. The program consisted of infrared diathermy, breathing exercise, chest mobility exercise, the active cycle breathing technique and static cycle or treadmill exercise program between January-June 2018.

Results: Subjects are ten COPD patients, the mean of age was 70 years old. The data of PCF, CATTM, and distance of 6MWT before intervention were 246± 57.19 L/ minute, 13.1± 6.36, and 296.4± 79.30. Therefore the PCF, CATTM, and distance in 6MWT after four weeks intervention were 269 ± 70.78 ($p< 0.05$), 15.2 ± 8.56 ($p> 0.05$), and 339.3 ± 62.55 ($p> 0.05$).

Conclusion: Rehabilitation program on COPD patient along four weeks improve the PCF, however did not improve the CATTM score and the distance of 6MWT.

Keywords: *6 Minute Walk Test (6MWT), Chronic Obstructive Pulmonary Disease (COPD), COPD Assesment Test (CAT) Score, Functional Parameter, Peak Cough Flow (PCF)*

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation due to airway and/or alveolar abnormalities. The etiology of COPD usually caused by significant exposure to noxious particles or gases. According to WHO in 2002, the COPD was the fifth leading cause of death, and in 2004 there were 64 million people have COPD and 3 million people died on COPD. Prediction by WHO, the COPD become the third leading cause of death in worldwide by 2030.[1] In Indonesia, according to basic health research by Health Ministry 2013, the COPD is the second most prevalent non-infectious disease with a prevalence of 3,7%.[2]

Patients with COPD have high risk to have disability and handicap. The most common respiratory symptoms include dyspnea, cough and/or sputum production.[1,3,4] When the disease becomes aggravated, patients suffer from deteriorated functional status and limitations to daily life. The impaired functional status is proven to be predictors of exacerbations, hospital admissions, and mortality.[5,6] The worsening functional status presents a tough challenge for patients and their families and causes an increasing burden for the society.[7] Therefore, assessing functional status accurately and systemically is one of demanding to require COPD treatments, as indicated in COPD guidelines.[3,8,9]

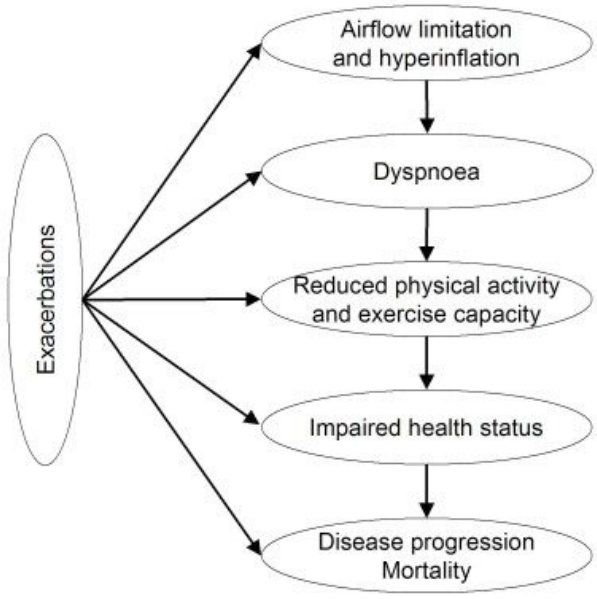

Figure 1. The Progression of COPD

For a thorough patient-centered outcome assessment and comprehensive management of the disease, measures of lung function, exercise capacity and functional capacity in activities of daily life are necessary.[4]

Pulmonary rehabilitation relieves dyspnea and fatigue, improves exercise capacity and emotional function, and enhances the sense of control individuals have over their health condition.[10,11] Thus, pulmonary rehabilitation is now recognized as a core component for the management of chronic respiratory diseases.[10] Because this intervention also aims to improve patients' ability to carry out daily tasks and to fulfill their social roles, measuring patient-centered outcomes such as activities of daily life and participation beyond the sole assessment of body structures and functions such as expiratory flows, and maximal oxygen

consumption based on cardiorespiratory exercise testing is crucial. Clinicians should thus be aware of existing and validated evaluation tools that are representative of patients' global functioning, and not only of their exercise tolerance. [12] But, the influence of lung physiotherapy in COPD was still debated. In this study the researcher wanted to evaluate the PCF, CAT™ score, and distance in 6MWT that are found to be the functional parameter of COPD patients after the physiotherapy.

Peak Cough Flow (PCF)

Cough is an innate defensive mechanism that prevents aspiration and clears airway debris. It is a physiological maneuver that requires optimal and coordinated use of the respiratory muscles, airway caliber, and larynx. Cough strength quantified objectively with peak cough flow (PCF) measurement, also known as cough peak expiratory flow (CPEF) measurement. [13] The difference from the peak expiratory flow is the higher glottis pressure and the higher resistance induced by the closed glottis, which characterizes a forced cough.

COPD Assessment Test™ (CAT™)

COPD Assessment Test™ (CAT™) is an 8-item unidimensional measure of health status impairment in COPD. [14] It was developed to be applicable worldwide and validated translations are available in a wide range of languages. The score ranges from 0-40, correlates very closely with the SGRQ, and has been extensively documented in numerous publications. [15]

6-Minute Walk Test (6MWT)

The principal outcome of this self-paced test is the distance covered, named 6-minute walking distance (6MWD). The 6MWT is commonly used to assess exercise capacity in patients with COPD and to track functional change resulting from disease progression or therapeutic intervention. So, distance covered has been the preferred outcome for this test.

The 6MWT has strong validity and reliability, with a large body of evidence to support its clinical and research use for a COPD population. Responsiveness to intervention has been confirmed after pulmonary rehabilitation with the mean effect of 44 m. [11,16]

METHODS

Study Design and Population

This study was retrospective cohort study of prospectively collected data from Medical Rehabilitation Clinic RSUP Persahabatan during January-June 2018. We enrolled data from patients with COPD GOLD A to D who underwent 4 weeks pulmonary rehabilitation program between the period. Patients were excluded if unable to attend pulmonary rehabilitation 3 times per week for 4 weeks. The data were obtained from the medical record at RSUP Persahabatan. PCF, CAT™ score and 6MWT measurement were performed by the attended physiatrist.

The intervention was pulmonary rehabilitation program 3 times per week for 4 weeks, consisted of infrared diathermy, breathing exercise, chest mobility exercise, the active cycle breathing technique and static cycle or treadmill exercise.

Peak Cough Flow (PCF)

Subjects were standing and asked to perform a maximal inspiration followed by a quick, short and explosive forced cough on the peak flow meter. Three measures were carried out and we considered the average of three results for each individual.[17]

The peak flow meter used was the Mini-Wright™ Peak Flow Meter Clement Clarke International Ltd from a plastic material, which makes it portable and easy to handle. It was used in order to assess the strength and speed exerted by the expiration in liters per minute (L/min). [17]

COPD Assessment Test™ (CAT™)

COPD Assessment Test™ (CAT™) is a simple system evaluating health status to evaluate the impact of COPD on health status.[14] CAT is a patient-completed questionnaire assessing globally the impact of COPD (cough, sputum, dyspnea, chest tightness) on health status, consists of 8 questions with scale 1 to 5. The range of CAT scores from 0–40. Higher scores denote a more severe impact of COPD on a patient's life. The difference between stable and exacerbation patients was five units. No target score represents the best achievable outcome.[18] The relationship between CAT score and FEV1% predicted suggests that CAT is linked to severity of airflow limitation and GOLD classification in stable COPD patients. Health status as measured by CAT worsens with the severity of airflow limitation.[19] The validation studies have shown that it has similar properties like St. George`s Respiratory Questionnaire (SGRQ). [14,15,19]

6-Minute Walk Test (6MWT)

The 6MWT is a self-paced walking test, which measures the distance covered by an individual over the course of 6 minutes while walking back and forth on a 30-m flat course. Clinic staff gave identical scripted instructions to participants and explained the Borg category ratio scale.[20] A staff member walked behind the participant and carried the oxygen delivery system if required. At each minute during the walk, the staff member told the participant how much time had elapsed and the remaining time and gave scripted encouragement. At the end of the 6 minutes, the participant was told to stop, and the distance walked was recorded. This test measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 minutes.[16,21,22]

Statistical Analysis

Statistical analysis was performed using IBM SPSS for Windows version 20. Kolmorogov-Smirnov normality test was used to evaluate the distributions of numeric data. Differences were considered statistically significant when the probability of a type I error was less than 5% ($p < 0.05$).

RESULTS

10 subjects were recruited, with the mean age was 70 ± 6.38 years old, CAT™ baseline score was 13.1 ± 6.36**,** 6MWD was 296.4± 79.30 m, and PCF was 246± 57.19 L/minute. The subject's baseline characteristic can be seen in **Table 1**.

Table 1. Baseline Characteristic

Baseline Characteristic	Mean ± SD
Age	70 ± 6.38 years old
CAT™ score	13.1 ± 6.36
6MWD	296.4± 79.30 m
PCF	246± 57.19 L/minute

After four weeks intervention, PCF value was 269 ± 70.78 L/minute ($p< 0.05$), CAT™ score was 15.2 ± 8.56 ($p> 0.05$) and 6MWD was 339.3 ± 62.55 m ($p> 0.05$). There were improvement in PCF value, CAT™ score and 6MWD after the intervention, but the significant improvement only found in PCF value.

Table 2. Comparison in PCF, CAT™ score, and 6MWD Before and After Pulmonary Rehabilitation

	Before PR*)	After PR*)	p-value
PCF (L/min)	246 ± 57.19	269 ± 70.78	<0.05
CAT™ score	13.1 ± 6.36	15.2 ± 8.56	>0.05
6MWD (m)	296.4± 79.30	339.3 ± 62.55	>0.05

DISCUSSION

The COPD prevalence highest among woman aged 65-74 years old, and among men aged 75-84. It was found in this study that the mean age of the participants were 70 years old. [23]

This study found there was significant improvement in PCF value after 4 weeks intervention of Pulmonary Rehabilitation. The PCF correlates with respiratory muscle strength, especially with inspiratory muscle strength. Respiratory and peripheral muscle dysfunctions have significant consequences for COPD patients. They are associated with reduced exercise tolerance and reduced quality of life. This study results supported the previous study that stated Pulmonary Rehabilitation in respiratory and peripheral muscle training has been shown to produce beneficial effects in respiratory muscle strength especially if they are used in combination with nutritional interventions and anabolic steroids. [18]

This study also found that CAT™ and 6MWD shown improvement after 4 weeks of intervention but not

significantly. This result is contrary from research from Karti et al that found significant improvement in 6MWD and CAT™ after 4 weeks of Pulmonary Rehabilitation.[19] This could be caused by the small sample size of the research.

CONCLUSION

Four weeks pulmonary rehabilitation program for COPD patients improve the functional parameter PCF value, CAT™ Score, and 6MWD, especially significant in the PCF value.

REFERENCES

1. WHO. Chronic obstructive pulmonary disease (COPD). [cited 2018 Oct 23]. Available from: http://www.who.int/respiratory/copd/en/
2. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI Tahun 2013, KEMENTERIAN KESEHATAN RI, TAHUN 2013. Riset Kesehatan Dasar 2013. 2013 [cited 2018 Oct 23]. Available from: http://www.depkes.go.id/resources/download/general/Hasil%20Riskesdas%202013.pdf
3. Global Initiative for Chronic Obstructive Lung Disease, Inc. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease 2018 Report. 2018 [cited 2018 Oct 23]. Available from: https://goldcopd.org/wp-content/uploads/2017/11/GOLD-2018-v6.0-FINAL-revised-20-Nov_WMS.pdf
4. Bui K-L, Nyberg A, Maltais F, Saey D. Functional Tests in Chronic Obstructive Pulmonary Disease, Part 2: Measurement Properties. Ann Am Thorac Soc. 2017;14(5):785–94.
5. Fan VS, Ramsey SD, Make BJ, Martinez FJ. Physiologic variables and functional status independently predict COPD hospitalizations and emergency department visits in patients with severe COPD. COPD: Journal of Chronic Obstructive Pulmonary Disease. 2007;4(1):29–39.
6. Pitta F, Troosters T, Probst VS, Spruit MA, Decramer M, Gosselink R. Physical activity and hospitalization for exacerbation of COPD. Chest. 2006;129(3):536–44.
7. Wang K-Y, Sung P-Y, Yang S-T, Chiang C-H, Perng W-C. Influence of family caregiver caring behavior on COPD patients' self-care behavior in Taiwan. Respir Care. 2012;57(2):263–72.
8. Celli BR, MacNee W, ATS/ERS Task Force. Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. Eur Respir J. 2004;23(6):932–46.
9. National Clinical Guideline Centre (UK). Chronic Obstructive Pulmonary Disease: Management of Chronic Obstructive Pulmonary Disease in Adults in Primary and Secondary Care [Internet]. London: Royal College of Physicians (UK). 2010 [cited 2018 Oct 23]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK65039/
10. Spruit MA, Singh SJ, 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;188(8):e13-64.
11. McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y. Pulmonary rehabilitation for chronic obstructive pulmonary disease. In: Cochrane Database of Systematic Reviews

[Internet]. John Wiley & Sons, Ltd. 2015. Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003793.pub3/abstract

12. Bui K-L, Nyberg A, Maltais F, Saey D. Functional Tests in Chronic Obstructive Pulmonary Disease, Part 1: Clinical Relevance and Links to the International Classification of Functioning, Disability, and Health. Ann Am Thorac Soc. 2017;14(5):778–84.
13. Jiang C, Esquinas A, Mina B. Evaluation of cough peak expiratory flow as a predictor of successful mechanical ventilation discontinuation: a narrative review of the literature. J Intensive Care. 2017;5(1):33.
14. Jones PW, Harding G, Berry P, Wiklund I, Chen W-H, Kline Leidy N. Development and first validation of the COPD Assessment Test. Eur Respir J. 2009;34(3):648–54.
15. Karloh M, Fleig Mayer A, Maurici R, Pizzichini MMM, Jones PW, Pizzichini E. The COPD Assessment Test: What Do We Know So Far?: A Systematic Review and Meta-Analysis About Clinical Outcomes Prediction and Classification of Patients Into GOLD Stages. Chest. 2016;149(2):413–25.
16. Pepin V, Brodeur J, Lacasse Y, Milot J, Leblanc P, Whittom F, et al. Six-minute walking versus shuttle walking: responsiveness to bronchodilation in chronic obstructive pulmonary disease. Thorax. 2007;62(4):291–8.
17. Cardoso FE, Abreu LC de, Raimundo RD, Faustino NA, Araújo SF, Valenti VE, et al. Evaluation of peak cough flow in Brazilian healthy adults. Int Arch Med. 2012;5:25.
18. American Thoracic Society - COPD Assessment Test (CAT) [Internet]. [cited 2018 Dec 5]. Available from: http://www.thoracic.org/members/assemblies/assemblies/srn/questionaires/copd.php
19. Ghobadi H, Ahari SS, Kameli A, Lari SM. The Relationship between COPD Assessment Test (CAT) Scores and Severity of Airflow Obstruction in Stable COPD Patients. Tanaffos. 2012;11(2):22–6.
20. Borg G. Psychophysical scaling with applications in physical work and the perception of exertion. Scand J Work Environ Health. 1990;16(1):55–8.
21. Sciurba F, Criner GJ, Lee SM, Mohsenifar Z, Shade D, Slivka W, et al. Six-Minute Walk Distance in Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 2003;167(11):1522–7.
22. Bennell K, Dobson F, Hinman R. Measures of physical performance assessments: Self-Paced Walk Test (SPWT), Stair Climb Test (SCT), Six-Minute Walk Test (6MWT), Chair Stand Test (CST), Timed Up & Go (TUG), Sock Test, Lift and Carry Test (LCT), and Car Task. Arthritis Care Res. 2011;63(11):350–70.
23. Akinbami LJ and Liu X. Chronic Obstructive Pulmonary Disease Among Adults Aged 18 and Over in the United States 1998-2009. 2011[cited October 2018]. Available from: https://www.cdc.gov/nchs/products/databriefs/db63.htm.