The Effect of the Combination of Extremity Training Up and Down on Respiratory Rate and Oxygen Saturation of Patients of Lung Disease Stable Chronic Obstructive

Hizkianta Sembiring[1], Amira Permatasari Tarigan[2], and Asrizal[3]

[1]*Master Student, Faculty of Nursing, Universitas Sumatera Utara*

[2]*Lecturer, Faculty of Medicine, Universitas Sumatera Utara*

[3]*Lecturer, Faculty of Nursing, Universitas Sumatera Utara*

shizkianta29@gmail.com

Abstract: Chronic obstructive pulmonary disease (COPD) is a chronic lung disease characterized by progressive non-reversible or partially reversible obstruction of airflow obstruction in the airways. This study aimed to determine the effect of a combination of upper and lower limb resistance training on respiratory rate and oxygen saturation in patients with chronic stable obstructive pulmonary disease undergoing medical rehabilitation programs. The study used a quasi-experimentaltwo-group pre-test post-test. The samples were selected by consecutive sampling technique.Data were analyzed using descriptive statistics, paired t-test and independent t-test.The mMRC scale was obtained the most at mMRC1.The frequency of patients with pulmonary function disorders in obstruction in the moderate category was 55.6% in the treatment group and 66.67% in the control group. Restrictions in the moderate category were 55.6% in the treatment group and 61.11% in the control group and the most Brinkman Index values were in the weight category of 55.6% in the treatment group and 72.22% in the control group. Respiratory frequency and oxygen saturation in the patient obtained a value of 91.38±2.25, then the oxygen saturation value decreased for a certain time to be 90.22±0.51. Whereas in the treatment group it was 92.06±2.88 while after the exercise it became 95.72±2.32. This study concludes that there is an effect of the combination of upper and lower limb resistance training on respiratory rate and oxygen saturation in patients with Chronic Stable Obstructive Pulmonary Disease.

Keywords:Exercises, Respiratory rate, Oxygen saturation, Chronicobstructive pulmonary disease.

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a disease caused by air pollution and is a type of respiratory disease that causes mortality and morbidity worldwide. Symptoms of COPD can be characterized by a progressive and uncured airflow caused by exposure to harmful particles or gases causing abnormalities in the respiratory tract (alveolar), a side effect of people with COPD in a long time, including physical inactivity, psychological problems, cardiovascular disease and lung cancer. World Health Organization (WHO) estimates that morbidity and mortality due to COPD will continue to increase and can become one of the main causes of death worldwide [1].

Data obtained by the WHO states that 3 million people (5% of the global human population) die due to COPD, in some low-income countries such as Africa, Liberia, Nigeria, Ethiopia and Congo, it is estimated that more than 90 % of people who die are caused by

COPD [2]. In Indonesia, the prevalence of people with COPD is ranked 6th out of 10 causes of deadly disease, with a death toll of 3.7%. The cause of death increases with age and tends to be male with a death rate of 4.2%, while women are 3.3% [3].

COPD can cause bad effects if not handled properly. Some of the problems that will be caused based on the reports of research results are shortness of breath, coughing, increased sputum production, hypoxemia and hypercapnia due to improper perfusion ventilation and diffusion limitations. Hypoxemia occurs due to the various ways oxygen and carbon dioxide bind to hemoglobin, so that oxygen supply is interrupted, blood in the arteries is deprived of oxygen and there is a decrease in oxygen saturation [4]. One of the solutions that have been proven to be effective as a therapy in COPD is to do breathing exercises that are designed and executed to achieve efficient and efficient ventilation, increase maximum alveolar inflation, increase muscle relaxation, eliminate anxiety, get rid of the activity pattern of the respiratory muscles useless, uncoordinated, slows down the frequency of breathing, and reduces trapped air. Regular exercise will also result in the increased beta-adrenergic activity of the respiratory tract which causes bronchial dilation and inhibits mucus secretion so that the lungs can enter and expel air better [5].

Other effective therapies are rehabilitation exercises that can affect lung repair and ventilation in COPD patients including deep breathing techniques, diaphragmatic breathing exercises, reconditioning exercises (aerobics and yoga), posture exercises, endurance exercises (ergo cycle and treadmill) and chest physical therapy [6]. In clinical practice, this technique can improve lung expansion, prevent respiratory muscle fatigue and reduce breathwork. However, this technique requires an instructor and is considered troublesome in its implementation, especially reconditioning exercises, endurance exercise (ergo cycle and treadmill) and chest physical therapy [6]. Based on the background that has been described, the researchers wanted to examine whether there was an effect of a combination of upper and lower limb resistance training on respiratory rate and oxygen saturation in patients with Stable COPD at USU Hospital Medan.

2. METHODS

This research is a quantitative research design using quasi-experimental research that applies the equivalent control group pre-test post-test design. This research was conducted for 1 month, starting from February- March 2020. The research site was carried out in the outpatient room in USU Hospital Medan. The samples obtained were 36 stable COPD patients. Sampling was carried out using a consecutive sampling technique. Inclusion criteria in this study were: 1) Patients with stable COPD who were outpatient, 2) Patients aged 40-70 years, 3) Do not have severe cardiovascular disorders such as acute coronary syndrome or acute on chronic heart failure, 4) did not use oxygen therapy in the long term, 5) conscious and cooperative, 6) able to communicate well 7) never received the same intervention from researchers or other health workers. While the exclusion criteria in this study were as follows: 1) Stable COPD patients who were hospitalized, 2) Patients aged <40-70 years, 3) Having severe cardiovascular disorders such as acute coronary syndrome or acute chronic heart failure, 4) Using oxygen therapy long term, 5) not cooperative, 6) unwilling to become respondents.

The data collection tool in this study was a demographic data questionnaire which included the characteristics of the respondents consisting of data on COPD sufferers, namely, age, gender, education, occupation and duration of suffering from COPD. Also, the researchers distributed a media leaflet in the form of a picture containing a combination of strength and resistance training for the upper and lower limbs. What can be done/practiced in patients with COPD who are being treated in the respiratory room at USU Hospital Medan.

The instruments were observation sheets, spirometric measuring instruments, blood pressure meters, stethoscopes, and pulse oximeters. To prove the changes that occurred were statistically tested using the paired T-test at the level of p <0.05. Data were analyzed using multiple linear regression statistical tests.

3. RESULTS

Based on the results of interviews with 7 patients who did not have a history of smoking, the researchers suspected that these 7 patients could experience COPD as a result of exposure to cigarette smoke inhaled by people who smoke or also known as passive smoking in the community. Based on the frequency distribution of stable COPD patients on the mMRC scale, the most patients were found in the mMRC 1 value, namely 7 patients (38.9%) in the treatment group and 9 patients (50%) in the control group. The results of the study on the most Brinkman index were in a severe category, namely 10 patients (55.6%) in the treatment group and 10 patients (55.6%) in the control group.

Table 1: Distribution of Frequency and Percentage of Respondents with stable COPD based on the characteristics of respondents in the intervention and control groups

Test group	Respondent characteristics	(n)	(%)
Long time smoking			
Control	No smoking	3	16,67
Intervention		2	11,11
Control	10-15	5	27,78
Intervention		5	27,78
Control	16-20	9	50
Intervention		8	44,44
Control	21-25	0	0
Intervention		1	5,56
Control	26-30	1	5,56
Intervention		2	11,11
mMRC group			
Control	1	9	50
Intervention		7	38,9
Control	2	2	11,11
Intervention		5	27,8
Control	3	7	38,89
Intervention		6	33,3
Pulmonary function disorders			
Control	mild obstruction	4	22,2
Intervention		4	22,2
Control	moderate obstruction	12	66,67
Intervention		10	55,6
Control	severe obstruction	2	11,11
Intervention		4	22,22
Control	mild restriction	4	22,22
Intervention		5	27,8
Control	moderate restriction	11	61,11
Intervention		10	55,6
Control	severe restriction	3	16,6
Intervention		3	16,6
Brinkman Index Category			
Control	mild	4	22,22
Intervention		7	38,8
Control	moderate	3	16,6
Intervention		1	5,6
Control	severe	10	55,6
Intervention		10	55,6

Table 2 shows the mean ± SD value of oxygen saturation before combination training in the control group, the value was 91.38 ± 2.25, while after the combination exercise in the treatment group the oxygen saturation value was 90.22 ± 0.51. Whereas in the treatment group the mean ± SD oxygen saturation before the combination exercise in the group obtained a value of 92.06 ± 2.88, while after the combination exercise in the treatment group the oxygen saturation value was 95.72 ± 2.32. Then performed statistical tests using Mann Whitney, the p-value in the control group was 0.030. Thus, there was an insignificant value of oxygen saturation before and after in the control group, namely from 1.72 to 1.16. While statistical tests using Mann Whitney obtained a p-value in the treatment group of 0.0001. Thus, there was a significant oxygen saturation value before and after in the control group, namely from 92.06 to 95.72.

Table 2: Observation Results of the Effect of Upper and Lower Extremity Resistance Exercises on the Oxygen Saturation of Patients with Stable COPD

Group	Saturation value Mean ± SD		p-Value
	Before	After	
Control	91,38 ± 2,25	90,22 ± 0,51	0,030*
Intervention	92,06 ± 2,88	95,72 ± 2,32	0,001*

Table 3 shows that patients with Stable COPD in the control group had the highest number of patients at the respiratory rate with a value of 3 (29-32 x/minute) and the degree of respiratory rate with a value of 4 (33-35 x/minute) while patients in the intervention group obtained 50% in the degree of respiratory rate with a value of 2 (25-28 x/minute), this indicates that upper and lower limb exercises can reduce the degree of respiratory rate based on the calculation of the respiratory rate that we do by inspection.Respiratory rate was carried out by inspection in patients with stable COPD with the control group was observed after the patient did the exercises in the exercise procedure.

Table 3: Respiratory rate distribution in patients with stable COPD based on inspection

Group	Inspection value	Number of patients		(%)
		Before	After	
Control	1	0	0	0,0
	2	2	3	16,7
	3	5	6	33,3
	4	7	6	33,3
	5	4	3	16,7
Intervention	1	1	5	27,8
	2	1	9	50
	3	1	4	22,2
	4	6	0	0
	5	9	0	0

4. DISCUSSION

The risk of developing COPD depends on the smoking dose, which is influenced by the age at which a person started smoking, the number of cigarettes smoked in a day and how long the person smoked. The dose can be calculated by the value of the Brinkman Index, which is the multiplication of the number of cigarettes smoked in a day and the length of time smoked in years [7]. Exposure is harmful inhalants such as cigarette smoke, which triggers an inflammatory response and attracts inflammatory cells, initiating an inflammatory response. When inflammation is triggered, a cascade of inflammation and pulmonary parenchymal damage occurs and persists. The dysregulation of the immune and inflammatory response mediates all stages in COPD, from initial to permanent lung damage, implying that COPD is an autoimmune disease. COPD in non-smokers may be associated with organ-specific autoimmunity [8].

Shortness of breath is persistent as well as progressive, symptoms of shortness of breath should be routinely evaluated in patients with COPD. Shortness of breath is usually assessed by calculating lung function with spirometry, but to assess shortness of breath in patients with COPD, mMRC questionnaires can also be used [9]. Shortness of breath is a major problem with COPD. Symptoms of shortness of breath can be routinely evaluated in each patient with COPD. Using the mMRC scale questionnaire was significantly associated with the value of the first second forced expiratory volume (VEP). Patients with COPD experience progressive airflow resistance so that they are unable to perform optimally for expiration, this disorder causes an increase in lung volume at the end of expiration (hyperinflation) with a consequence of a decrease in inspiratory capacity. Hyperinflation at rest and during activities contributes to the shortness of breath that sufferers always complain about. The presence of airflow resistance is evidenced by lung function examination which is marked by a decrease in the VEP value and a decrease in the VEP/KVP ratio [10].

Impaired lung function ventilation is a condition where the amount of air that enters the lungs is reduced from the normal amount. Airway obstruction is caused by increased resistance to airflow. The cause of this increase is a condition in the lumen that is partially blocked due to excessive secretion, thickening of the airway wall due to edema or hypertrophy of the muscles and other consequences outside the respiratory tract such as partially damaged lung parenchyma and airway constriction due to loss of radical traditions. . Restriction is associated with limited lung expansion, which is due to changes in the lung parenchyma or the presence of disease in the pleura, chest wall and neuromuscular apparatus. Reduced vital lung capacity, causes the proportion of FEV1 to decrease, causing the percentage of FEV1/FVC to decrease [11.

COPD is caused by chronic inflammation due to exposure to toxic particles or gases that occur over a long time. Cigarette smoke is the most important cause of COPD, so smoking is a major risk factor. The decrease in lung function varies and is a "dose-response relationship". Active smokers have a higher prevalence of respiratory symptoms, pulmonary function abnormalities, and higher mortality than non-smokers [12].

Breathing in patients with Stable COPD is caused by the mechanism of action of the respiratory muscles, increased chest wall resistance, lack of oxygen intake into the body, impaired gas exchange, airway obstruction, and weakness of the respiratory muscles. These causes can be overcome by doing activities or exercises by striving to increase the activity of the inspiratory efferent nerves in the diaphragm muscle, increase in reflex chemoreceptor from abnormalities of the alveolar ventilation (perfusion) process and oxygen desaturation, these efforts can overcome the sensation of feeling short of air and dyspnea in when doing upper and lower resistance training activities. Upper body muscle stretching is also capable of optimizing the neuromechanical function of the decreased respiratory muscles in patients with stable COPD. The existence of stretching of the upper body muscles accompanied by diaphragmatic breathing exercises can help reduce dyspnea during activity, thereby increasing exercise capacity and endurance in patients with stable COPD [13]

Fatigue in the large muscles, especially in the lower extremities, is the most influencing factor in the low mobility of people with COPD. At the same time, decreased mobility will further exacerbate ongoing muscle atrophy. All of these conditions form an endless cycle of deconditioning and worsening the quality of life for people with COPD. Muscle dysfunction in COPD patients occurs in the respiratory muscles located in the thoracic and peripheral muscles (upper and lower extremities). Studies say that when compared with muscles in the upper extremities and respiratory muscles. Respiratory rehabilitation has been recommended as the standard of management in patients with COPD. The most potential therapeutic option for limb muscle dysfunction today is exercise therapy, which is a key component of COPD management. Endurance training is a very effective way to recondition the muscles of patients who have experienced decondition in the hope of being able to improve cardiorespiratory fitness as measured by oxygen saturation [14].

Oxygen needs of healthy adults at resting conditions averaging 53 liters of oxygen per hour, while breathing an average of about 500 mL of air per breath. This is called normal tidal volume. that is, 150 mL of air will go to the non-functioning areas of the lungs, this is called "dead space". Normal oxygen saturation is between 95-100%. In medicine, oxygen saturation (SpO_2), often referred to as "SATS", measures the percentage of oxygen bound by hemoglobin in the bloodstream. At low oxygen partial pressure, most of the hemoglobin is deoxygenated, which means the process of distributing oxygenated blood from the arteries to body tissues. At about 90% (values vary according to clinical context) oxygen saturation increases according to the hemoglobin oxygen dissociation curve and approaches 100% at oxygen partial pressure>10 kPa. A pulse oximeter relies on the light absorption characteristics of saturated hemoglobin to indicate oxygen saturation [15].

Respiratory rate is a major problem in patients with stable COPD and a reason sufferers seek treatment. The respiratory rate is persistent and progressive and also causes the patient's inability to perform activities. The respiratory rate should be evaluated routinely in every patient or patient with stable COPD. Respiratory rate is usually assessed by calculating lung function using spirometry, but to assess the degree of respiratory rate in patients with Stable Chronic Obstructive Pulmonary Disease can also be used or directly measure and assess the respiratory rate (RR) experienced by patients, patients with stable COPD. The research in Lebanon states that the degree of respiratory rate of patients or patients with Stable COPDaccording to the measurement of respiratory frequency by counting is significantly related to the value of the expiratory volume of 5,6,7 forced first seconds [10]

COPD is preventable and treatable. It is characterized by persistent and progressive airflow resistance accompanied by increased chronic inflammatory responses of the airways and lungs to harmful particles. The opinion of researchers that the cause of shortness of breath is not only due to bronchial obstruction or bronchospasm but rather due to hyperinflation. Therefore, handling COPD does not only rely on pharmacological therapy, but non-pharmacological therapy is also an important thing that must be done to reduce shortness of breath [16]. Resistance training can increase inspiratory muscle strength as well as lung volume after maximal inspiration. This situation will affect the elasticity of the lung recoil so that it can improve breathing efficiency, thereby reducing the degree of tightness, which in turn can increase the activities of daily life. Because resistance training can improve lung function, oxygen intake during inspiration will increase, oxygen perfusion from the alveoli to hemoglobin and hemoglobin capture capacity also increases because exercise will increase oxidative enzymes and myoglobin trapping power to oxygen. This situation explains that resistance training can increase the functional capacity of people with allergic bronchial asthma. There is an increase in functional capacity which can be measured by a 6-minute walk test mileage. Because the intensity of the exercise is not strong enough to stimulate lung function, oxygen intake and oxygen diffusion are relatively lower in diaphragmatic breathing exercises when compared to incentive spirometry [17].

5. CONCLUSIONS

The combination action of upper and lower limb resistance training against oxygen saturation is based on statistics using the Mann Whitney test which states that there is a significant effect on patients undergoing exercise with a p-value in the treatment group of

0.001< 0.05 and a pre and post oxygen saturation value in the control group, namely from 92.06 to 95.72.

6. REFERENCES

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