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The Effect of the Combination of Chest Physiotherapy and Active Cycle Breathing Technique on Respiratory Rate and Ability to Expend Sputum in Chronic Exacerbation Obstructive Lung Disease Patients at Haji Adam Malik Hospital Medan

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*Abstract:***Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death in the world but is projected to be the third leading cause of death in 2020. This study aimed to examine the effect of combined chest physiotherapy and Active Cycle Breathing Technique (ACBT) on oxygen saturation and respiratory rate. The research method used was a quasi-experimental approach with pre-test and post-test control group design. The sampling technique used by the researcher was purposive sampling with 60 respondents, divided into 30 intervention groups and 30 control groups. The results obtained were there were significant differences in the respiratory rate in the control group and the intervention group after being treated with a value of p=0.001 (p <0.05). The difference in the proportion of the ability to excrete sputum in the intervention group was 7 times more productive than the control group. It is hoped that nursing practice and nursing education will increase knowledge and skills in providing chest physiotherapy and ACBT so that they can apply these actions to patients who have sputum retention problems in the airway, especially COPD patients.**

*Keywords:***COPD, Chest physiotherapy, ACBT, Respiratory rate, Ability to expend sputum**

1. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is one of the diseases that has the highest health burden. COPD is currently the 4th leading cause of death in the world but is projected to be the 3rd leading cause of death by 2020. GOLD [1] said that the prevalence of COPD incidence in the world is on average 3-11% and the highest prevalence of COPD in the country. Southeast Asian countries are in Vietnam (6.7%) and China (6.5%) of the total population. The incidence of this disease is higher in men (4.2%) than women (3.3%) and increased with age. Many people suffer from this disease for years and die sooner than it or its complications. More than 3 million people die from COPD. In 2012, COPD accounted for 6% of all deaths worldwide [1]. According to PDPI [2], the current and future prevalence of COPD in Indonesia is expected to have a major impact, along with the increasing number of smokers, poor ventilation, industrial air pollution and vehicle fumes which are risk factors for the disease.

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COPD is an irreversible disease, but with effective treatment, it can control and slow down the progression of COPD. An acute exacerbation of COPD means an onset of worsening compared to the previous condition. The exacerbation of COPD is a major cause of hospitalization in adults, especially the elderly. The average length of stay of COPD patients was 7 days without complications and 10 days in COPD patients with complications [3]. Inability to do activities in COPD clients occurs not only due to shortness of breath that they have experienced for years but is exacerbated by decreased skeletal muscle function due to reduced client activity (deconditioning syndrome) [4].

Based on the above phenomena, the management of COPD does not only rely on pharmacological aspects, but non-pharmacological therapy is also an important thing that must be done. As a professional nurse, you must be able to help COPD patients recover their physical condition and improve their breathing patterns by breaking the chain of complaints [5]. One of the management programs for COPD clients in both stable and exacerbated conditions is pulmonary rehabilitation. The components of pulmonary rehabilitation consist of education and physical therapy; breathing exercises, chest physiotherapy, postural drainage. The rehabilitation aims to clear the airway, improve pulmonary function, overcome clinical symptoms such as the ability to expel excessive sputum and shortness of breath which disrupts thoracic development, decreased oxygen saturation and increased patient length of stay [2].

The Active Cycle of Breathing Technique (ACBT) is a series of breathing exercises that aim to help mobilize and clear excess secretions from the respiratory tract. ACBT includes a controlled breathing cycle, thoracic expansion exercises and forced expiration techniques. This is effective in improving lung function and can reduce obstruction of airflow and is effective in clearing bronchial secretions [6]. Chest physiotherapy is a non-pharmacological therapy consisting of postural drainage, percussion, and vibration which functions to help remove mucus secretions in COPD patients. Chest physiotherapy aims to help release or remove secretions attached to the airway by utilizing the force of gravity and reducing the accumulation of secretions in patients [7].

According to a study conducted by Pawadshetty et al. [8], comparing the effectiveness of ACBT with autogenic drainage in COPD patients, said that the active cycle of breathing technique is more effective than the Drainage Autogenic Technique to increase the peak expiratory flow rate and reduce the rate of dyspnea in patients with COPD between groups. According to Syed et al. [9], in their study aimed to compare the effectiveness of ACBT with conventional physiotherapy in clearing the airway of sputum in patients with bronchiectasis, it shows that ACBT has the same effectiveness as conventional physiotherapy.

2. METHODS

The study was quasi-experimental with a pre-test and post-test control group design approach, namely making a comparison between the intervention and the control group before and after being given treatment. In this study, the level of significance (α) was set at 0.05 with an effect size (γ) of 0.80. So that the sample size in this study was 60 respondents (30 intervention and 30 control groups). The study was the purposive sampling technique. The sample were patients suffering from an exacerbation of COPD who met the requirements. The instrument used for measuring respiratory frequency using a watch and the ability to remove sputum by observation.

The research implementation procedure was carried out by pre-test and post-test in the control and the intervention group. On the first day, the researchers measured the respiratory rate and the ability to excrete sputum in the intervention and control groups. The measurement results were documented in a data tabulation sheet. At the intervention stage, the researcher gave chest physiotherapy and ACBT to the intervention group, while the

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control group was given chest physiotherapy. Each respondent was given chest physiotherapy and ACBT interventions once a day for 3-5 cycles for three days. The measurement of respiratory frequency and the ability to excrete sputum was carried out in a time series, namely measuring the dependent variable every day after being given treatment for three days.

Normally distributed variables were performed by using parametric statistical tests, namely paired T-Test and Independent T-Test. The variable of ability to excrete sputum used Fisher's test by looking at the Odds Ratio (OR) value to assess the different proportions of the ability to excrete sputum in the control and intervention groups.

3. RESULTS

Characteristics of respondents in this study found that the majority of respondents in the intervention and control groups were aged 55-64 years. The intervention group was 15 people (50%) and the control group was 12 people (40%). The frequency distribution of respondents based on gender in the two groups was more male, namely the intervention group as many as 23 people (76.7%) and the control group as many as 21 people (70%). Based on the length of smoking, the majority of respondents had a smoking duration> 10 years, namely the intervention group 13 people (43.3%) and the control group 14 people (46.7%). The majority of respondents in both groups spent> 2 packs of cigarettes per day, namely the intervention group as many as 12 people (40%) and the control group as many as 12 people (40%). Based on the characteristics of the peak expiratory flow, the majority of respondents have peak expiratory flow in the yellow zone category (50-80%). The intervention group consisted of 19 respondents (63.3%) and the control group as many as 21 people (70%).

Based on the results of the study, there was a decrease in the respiratory rate of the responder noble from the first day to the third day both in the control and intervention groups. The mean value of respiratory rate on the first day in the intervention group was 27.10 times/minute, with a standard deviation of 2.325 and in the control group was 28.30 times/minute with a standard deviation of 2.641. The respiratory rate on the second day in the intervention group was 26.53 times/minute with a standard deviation of 2.030 and the control group was 26.90 times/minute with a standard deviation of 2.510. On the third day, the respiratory rate in the intervention group was 24.67 times/minute with a standard deviation of 1.845 and the control group was 25.30 times/minute with a standard deviation of 1.915.

Table 1: The results of the analysis of the respiration rate values of the respondents before the intervention in control and intervention groups

Respiratory rate		Respiratory rate	Std.Devices	Min-Max	95%CI
First day	Intervention	27,10	2,325	24-32	26,23-27,97
	Control	28,30	2,641	23-34	27,31-29,29
Second day	Intervention	26,53	2,030	24-30	25,78-27,29
	Control	26,90	2,510	22-32	25,96-27,84
Third day	Intervention	24,67	1,845	22-28	23,98-25,36
	Control	25,30	1,915	22-30	24,59-26,01

The respiratory rate value for the first day in the intervention group was 25.17 times/minute, with a standard deviation of 2.379 and in the control group, it was 28.93 times/minute with a standard deviation of 2.504. The respiratory rate on the second day in the intervention group was 24.53 times/minute with a standard deviation of 1.961 and the control group was 25.67 times/minute with a standard deviation of 2.617. On the third day, the

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respiratory rate in the intervention group was 21.90 times/minute with a standard deviation of 2.398 and the control group was 23.63 times/minute with a standard deviation of 2.356.

Table 2: The results of the analysis of the respiration rate values of the respondents after the intervention in control and intervention groups

Respiratory rate		Mean (%)	Std.Devices	Min-Max	95%CI
First day	Intervention	25,17	2,379	20-30	24,28-26,06
	Control	28,93	2,504	24-34	28,00-29,87
Second day	Intervention	24,53	1,961	22-28	23,80-25,27
	Control	25,67	2,617	20-30	24,69-26,64
Third day	Intervention	21,90	2,398	18-26	21,00-22,80
	Control	23,63	2,356	19-28	22,75-24,51

On the first day, the majority of respondents could produce unproductive sputum, namely 18 respondents in the intervention group (60%) and 20 in the control group (66.7%). On the second day, the ability to release sputum in the intervention group was 15 people (50%) unproductive and 15 respondents (50%) productive, while in the control group 60% (18 respondents) were unproductive and 40% (12 respondents) productive. On the third day, the intervention group was 66.7% (20 respondents) could produce productive sputum and the control group was 53.3% (16 respondents).

Table 3: Frequency distribution of the respondent's ability to produce sputum before the intervention

Ability to expend sputum		No productive		Productive	
		f	%	f	%
First day	Intervention	18	60	12	40
	Control	20	66,7	10	33,3
Second day	Intervention	15	50	15	50
	Control	18	60	12	40
Third day	Intervention	10	33,3	20	66,7
	Control	14	46,7	16	53,3

On the first day of respondents who could produce unproductive sputum, the intervention group was 40% (12 respondents) and the control group was 60% (18 respondents). On the third day of respondents who can produce productive sputum after being given treatment (after intervention) in the intervention group was 80% (24 respondents) and the control group was 60% (18 respondents).

Table 4: Frequency distribution of the respondent's ability to produce sputum before the intervention

Ability to expend sputum		No productive		Productive	
		f	%	f	%
First day	Intervention	12	40	18	60
	Control	18	60	12	40
Second day	Intervention	10	33,3	20	66,7
	Control	16	53,3	14	46,7
Third day	Intervention	6	20	24	80
	Control	12	40	18	60

The mean value before the intervention was 26.10 and the mean value after the intervention was 23.87. The difference between the mean before the intervention and after the intervention was 2.233 with a value of t = 11.599. Based on the statistical test value, the value of p=0.001 (p<0.05) was obtained. This shows that there was a significant difference in the respiratory rate before and after the intervention in the intervention group.

Table 5: Analysis of differences in the respiratory rate before and after intervention in the intervention group

Respiratory rate	Mean	Std.Devices	Mean different	t	p-value
Before intervention	26,10	1,952	2,233	11,599	0,001

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After intervention	23,87	2,056			

The mean value before the intervention was 23.63 and the mean value after the intervention was 26.08. The difference between the mean before the intervention and after the intervention was 2.444 with a value of t = 10.753. Based on the statistical test value, the value of p = 0.001 (p <0.05) was obtained. This shows that there is a significant difference in respiratory frequency before the intervention and after the intervention in the control group.

Table 6: Analysis of differences in the respiratory rate before and after intervention in the control group

Respiratory rate	Mean	Std.Devices	Mean different	t	p-value
Before intervention	23,63	2,356	2,444	10,753	0,001
After intervention	26,08	2,257			

The combination of chest physiotherapy and ACBT had a significant effect on respiratory frequency in the intervention group than in the control group which was given only chest physiotherapy. Based on the results of statistical tests, the p-value was 0.001 (p <0.05). This suggests that the combination of chest physiotherapy and ACBT is effective in reducing the respiratory rate in exacerbated COPD patients.

Table 7: Analysis of differences in respiratory frequency in the intervention group and the control group

Respiratory rate	Mean	Std.Devices	Mean different	t	p-value
Before intervention	23,87	2,056	2,211	3,967	0,001
After intervention	26,08	2,257			

The ability to expend unproductive sputum in the control and intervention groups 8 people (26.7%). The ability to produce productive sputum in the control and intervention groups was 19 people (63.3%). The proportion of unproductive sputum was 20 people (66.7%) and the proportion of productive sputum was 10 people (33.3%). Based on the statistical test with Fisher's test, the value of p = 0.035 (p <0.05) was obtained, meaning that there was a difference in the proportion of the ability to excrete sputum in the control group and the intervention group. Based on the Odds Ratio (OR) value, the proportion of the ability to produce sputum in the intervention group was 7 times more productive than the control group.

Table 8: Analysis of differences in the ability to excrete sputum in the intervention and control group

		Intervention		Total	OR	p-value
		No productive	productive			
Control	No productive	8 (26,7%)	3 (10%)	11 (36,7%)	7	0,035
	productive	12 (40%)	7 (23,3%)	19 (63,3%)		
Total		20 (66,7%)	10 (33,3%)	30 (100%)		

4. DISCUSSION

The results showed differences in respiratory rates before and after being given a combination of chest physiotherapy and ACBT in the intervention group and the control group. In the intervention group, there was a significant difference in the respiratory rate before and after the intervention was given with a value of p = 0.001 (p <0.05) and in the control group there was also a significant difference in the respiratory frequency with a value of p = 0.001 (p <0.05).

In the case of COPD, there is a decrease in elasticity of the lung parenchyma, and hypertrophy of the bronchial mucosal glands which increases resistance in the airway, which is characterized by an increase in respiratory rate, shortness of breath and uncontrolled

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breathing patterns. The loss of lung elasticity in COPD causes hyperinflation and chronic obstructive airway which interferes with the expiration process so that the volume of air entering and leaving is unbalanced and there is air trapping.

In COPD, respiratory muscle disorders are affected, which is influenced by muscle contraction and respiratory muscle strength. The Respiratory Rate (RR) is the number of breaths taken per minute. In a resting state, the respiratory rate is about 15 times per minute [10]. The Respiratory Rate (RR) increases in an attempt to compensate for the small volume of the breath square [11]. Chest physiotherapy is a group of therapies used in combination to mobilize pulmonary secretions from the lung segments so that atelectasis does not occur. ACBT is an exercise that consists of three cycles, namely breathing relaxation, thoracic expansion exercises and active secretion by using forced expiration (huffing) techniques. The combination of chest physiotherapy and ACBT affects reducing the respiratory rate in exacerbated COPD patients.

After the combined management of chest physiotherapy and ACBT, it was reported that the complaints of shortness of breath felt by the respondents were reduced and the adequate SpO2 values ranged from 95% - 98%. Breathing exercises performed during ACBT produce an increase in transpulmonary pressure, expand lung tissue and mobilize secretions from the bronchi. Lamuvel et al. [12] examined the oxygen saturation response in patients who had been given ACBT. The results showed that there were significant differences in PCO2 and oxygen saturation in the intervention group.

Description of the ability to remove sputum after being given treatment in the intervention andcontrol group on the first day of respondents who could remove unproductive sputum in the intervention group was 40% (12 respondents) and the control group was 60% (18 respondents). On the third day of respondents who can produce productive sputum after being given treatment (after intervention) in the intervention group was 80% (24 respondents) and the control group was 60% (18 respondents). The ability to remove sputum in the control group and the intervention group continued to increase until the third day.

The results showed that the ability to remove sputum in both groups had increased because both the intervention group and the control group received medication therapy as the standard for the management of COPD exacerbations in the hospital. Increased sputum secretion is the earliest clinical manifestation of COPD (bronchitis). Sputum can contain cell debris, mucus, blood, pus, or microorganisms [13]. However, the ability to remove sputum released in the intervention group that was given a combination of chest physiotherapy and ACBT was greater than the ability to excrete sputum in the control group who was only given chest physiotherapy intervention.

Active Cycle of Breathing Technique (ACBT) is a non-pharmacological therapy that aims to clear the airway of sputum which is a product of infection or disease pathology that must be removed from the airway to reduce shortness of breath, reduce coughing, improve breathing patterns, and increase chest wall mobilization [14]. Several studies have stated that ACBT is an effective technique in cleaning sputum, with mean differences showing an increase in the amount of sputum that can be removed during and up to one hour after being given ACBT [15][16]. These results indicate that by giving a combination of chest physiotherapy and ACBT, exacerbated COPD sufferers can more easily excrete sputum so that the airway is cleared and the cough complaints are felt to be reduced.

Comparison of the mean value of respiratory frequency in the intervention group and the control group after being given the intervention showed that the mean value of the intervention group was 23.87 times/minute and the mean value of the control group was 26.08 times/minute with t count of 3.967 and p-value = 0.001 (p <0, 05). This shows that there is a significant difference in the mean value of respiratory frequency between the intervention group and the control group.

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According to Huriah et al. [17], it was found that there was a decrease in the degree of shortness of breath after being given 4 (four) chest physiotherapy actions. The breathing exercise technique can reduce shortness of breath because it can increase lung volume, increase ventilation and retribution, keep the alveolus growing, increase oxygenation, help clear mucosal secretions, mobility of the thoracic cage, increase endurance strength and efficiency of the respiratory muscles so that the lungs - lungs can work optimally and shortness of breath is reduced [18]. Breathing exercise with the Thoracic expansion exercise method aims to improve lung function and increase the amount of air that can be pumped by the lungs so that it can maintain the performance of the muscles of the breathing aids and can maintain and increase the expansion of the thoracic cage [19].

Comparison of the value of the proportion of the ability to excrete sputum in the intervention group and the control group after being given the intervention, the results of statistical tests were obtained with Fisher's test p-value = 0.035 ($p < 0.05$). Thus, Ha is accepted, namely that there is a difference in the proportion of the ability to remove sputum in the control group and the intervention group in exacerbated COPD patients. Based on the Odds Ratio (OR) value, the proportion of the ability to excrete sputum in the intervention group was 7 times more productive than the control group.

Active Cycle Breathing Technique that emphasizes maximum inspiration starting from expiration, which aims to stimulate the opening of the collateral system, increase the distribution of ventilation, increase lung volume, facilitate the cleaning of the airways which allows the patient to remove secretions/mucus from the upper and lower airways [18].

Chest physiotherapy is a procedure consisting of postural drainage, chest percussion, and vibration which aims to help remove mucus secretions in patients who experience retained secretions and experience respiratory problems. Active Cycle Breathing Technique (ACBT) is an action that can be used to mobilize and clean excess pulmonary secretions in chronic lung disease and in general improve lung function which consists of three cycles, namely breathing relaxation, thoracic expansion exercises and active secretions with the technique forced expiration (huffing).

5. CONCLUSIONS

There was a significant difference between the respiratory rate in the intervention group and the control group with a value of $p=0.001$ ($p<0.05$) and the mean difference was 6.633. There was a difference in the proportion of the ability to excrete sputum in the intervention group and the control group with a value of $p=0.035$ ($p=<0.05$). Based on the OR value, the ability to produce sputum in the intervention group was 7 times more productive than the control group.

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