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Comparison of training pursed lip breathing and balloon blowing on the increasing of respiratory muscle strength, respiratory rate and the increasing of oxygen saturation in COPD at the Makassar community lung health center

Junaidin
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia
Email: junaidinlaode09@gmail.com

Dewi Sartika
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia

Hasliani
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia

Fitriani
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia

Rachmat Ramli
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia

Nelly Nugrawati
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia

Muhammad Qasim
Sekolah Tinggi Ilmu Kesehatan Amanah Makassar, Indonesia

Haeril Amir
Universitas Muslim Indonesia, Makassar, Indonesia

Livana PH
Sekolah Tinggi Ilmu Kesehatan Kendal, Indonesia

***Abstract*---**Background: Chronic Obstructive Pulmonary Disease (COPD) is one of lung disorders that affect air movement from and out

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***Corresponding author**: Junaidin, J.; Email: junaidinlaode09@gmail.com*
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of the lung, this can lead to hypoxemia and hypercapnia due to the occurrence of respiratory muscle weakness and obstruction. As the result, it will increase airflow resistance, pulmonary hyperinflation also ventilation and perfusion imbalances . One of the pulmonary non-pharmacological treatments that can be given to COPD patients includes the pursed lip breathing exercise (PLB) technique and blowing balloons. This rehabilitation exercise aims to improve lung function, prevent damage, and improve quality of life.Objective: To know the differences in pursed lip breathing exercises and balloon blowing in increasing the respiratory muscle strength, respiratory rate and increaseing the oxygen saturation in COPD patients.Method: This study was a Quasi-Experimental study, with pre-posttest design in two different comparison groups.Results: Increased breath muscle strength and significance difference on the third day after the intervention of balloon blowing (median = 5870) and PLB (median = 5830) obtained p value <0.001, while the seventh day after the balloon blew intervention (median = 5980) and PLB (median = 5880) Significant differences were obtained with a value of p <0.001. For the respiratory rate there was a significant clinical improvement (median pre-intervention = 22), after the third day intervention balloon blowing scores (median = 19) and PLB (median = 19) were obtained. so that the value of p <0.057, while on the seventh day blowing balloons (median = 17) and PLB (median = 17) obtained a value of p> 0.964. There were clinical increase in the oxygen saturation, depicted by the median value that obtained before intervention was 94, but there was no difference in improvement between the two interventions, the third day there were no significant statistical and clinical differences after the balloon blowing intervention (median = 96) and PLB (median = 96), while the seventh day blows balloons and PLB (median = 99), p value> 0.181.Conclusion: Blowing balloons is very significant in increasing breath muscle strength in comparison to PLB in COPD patients, but there is no difference between balloon blowing and pursed lip breathing in decreasing the respiratory rate and increasing oxygen saturation in COPD patients.

***Keywords*---**pursed lip breathing, balloon blowing, breath muscle strength, respiratory rate, oxygen saturation, COPD.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a one of lung disorder that affect air movement from and out of the lung, this can lead to hypoxemia and hypercapnia due to the occurrence of respiratory muscle weakness and obstruction. As the result, it will increase air flow resistance, pulmonary hyperinflation and ventilation as well as perfusion imbalances.

One of the clinical manifestations shown in COPD patients is dyspnea that can cause a decrease in oxygen saturation (LeMone, Priscilia, et al, 2016). The prevalence of this disease vary throughout the world, in twelve Asian countries

there were 6.3% (Regional COPD Working Group, 2015), while in the United States COPD was the third leading cause of death (American Lung association, 2015). Result from Basic Health Research (2013)shows that in Indonesia there are 4.8 million COPD patients with a prevalence of 5.6%. COPD in South Sulawesi is the first cause of death for inpatient in hospital for non-communicable diseases, which counted up to 43 cases in 2016 (Profile of the health office of South Sulawesi Province, 2016). The mortality rate for this disease is increasing (Windrasmara, 2012). It is estimated that by 2030, COPD will be the leading cause of death worldwide (WHO, 2015). The prevalence of COPD in the world ranges from 3-11% in average (GOLD, 2015).

Medical Record Results of the Center for Community Lung Health (BBKPM) was there were 578 COPD patients with 1075 outpatient visits in 2016, whereas in 2017 there were 588 patients with 1253 outpatient visits of COPD patients, each month there were 49 patients. The increasing number of people with COPD will cause an increasing in population mortality and a decreasing in the quality of life of the community due to several factors. Thus, COPD is requiring good treatment for long periods of time from health workers and patients with COPD (GOLD, 2015).

The results of the Center for Medical Record COPD can be complicated and require a long time for healing process if there were no good care and training. One of the non-pharmacological treatments for COPD is rehabilitation exercises. COPD management with rehabilitation exercises aims to improve lung function, prevent damage, and improve quality of life (C.P. Engstrom, et al 2001). One of the treatments for pulmonary rehabilitation that can be given to COPD patients is by pursuing a pursed lip breathing exercise and balloon blowing techniques that can be used as one of the independent nursing interventions (Smeltzer, 2008). This non-pharmacological treatment, specifically pursed lip breathing exercise and balloon blowing techniques can improve lung development to be more optimal and prevent respiratory muscle fatigue, so that COPD patients can achieve more controlled ventilation, efficiently and reduce breathing work, breathing becomes slow and deep, and oxygen transport gets better (Smaltzer& Bare, 2013).Pursed lip breathing is a breathing technique with the expiration process carried out by holding the air released through shrinking the lips with the aim to slow down the expiration process, making the lips pursed as if blowing a candle, allowing a complete air exchange in the lungs and making it easier to breathe, giving the lungs small pressure returns, and keeps the airways open for a long time so that it can facilitate the oxygenation process in the body. When the oxygenation is smooth, it can increase oxygen saturation in patients with COPD (Smeltzer, 2008). Balloon blowing is a therapy that requires deep inspiration and long expiration. The aim of this therapy is to train the expiratory breathing to be longer than inspiration. So it can facilitate the release of carbon dioxide from the body which is retained due to airway obstruction (Hockenbbery, 2010).

Therefore the aim of this study is to discover how the comparison of pursed lip in breathing exercises and balloon blowing to increase respiratory muscle strength, respiratory rate and increase oxygen saturation in patients with chronic obstructive pulmonary disease in the Makassar Center for Lung Health. The research hypotheses are as follows: There is a difference between pursed lip

breathing and balloon blowing for respiratory muscle strength in COPD patients. There is no difference between pursed lip breathing and balloon blowing for the respiratory rate in COPD patients, there is no difference between pursed lip breathing and balloon blowing to increase oxygen saturation in COPD patients at the Lung Health Center of Makassar City.

Method

This research is a quantitative research with Quasi-Experimental design. This research method used two research groups, both groups were given a pre test, then given treatment, and finally were given a post test. The intervention given in the two groups was different, the pursed lip breathing group was given a purshed lip breathing treatment and the group blew the balloon and was given a balloon blowing treatment. The population in this study were all patients with Chronic Obstructive Pulmonary Disease (COPD) who underwent outpatient care in the Makassar Center for Community Lung Health (BBKPM), amounting to 588 patients in 2017 and 49 per month for outpatient treatment.

The sample was determined by using a minimum sample of 10 respondents per group, consisting of two intervention groups (Siegel & Castellan, 1988). In each group, 15 samples were used to increase power and reduce the risk of sample deficiencies if in any occasional there is a sample that drops out. So overall there were 30 samples that were involved in this study. Sampling method in this study was Non random sampling with Purposive Sampling technique with the following criteria: inclusion criteria: Patients diagnosed with mild grade COPD (FEV / FVC <70% Spyrometry, FEV> 80%) according to diagnosis from doctor, Patients were aged 20 -65 years, patients who did not receive bronchodilators. The exclusion criteria were: patients who are not willing to be studied, exacerbated COPD patients, patients who are using oxygen therapy.

The instrument in this study used portable pulse oximetry for monitoring oxygen saturation, Spirometry to measure respiratory muscle strength which can be assessed through measuring lung capacity on total lung capacity (TLC), Metallic Latex Balloons are balloons made from German latex, the strength of the balloon surface will not thin when blown to a large size, this is used as a balloon blowing exercise for the group blowing balloons.

The study was firstly conducted by measuring respiratory muscle strength, respiratory rate, and measuring oxygen saturation levels in the pre-selected patients in the pursed lip breathing group and the balloon blowing group. All results from the interventions are documented in an observation sheet. The next step was doing the pursed lip breathing exercise in the pursed lip breathing group and doing balloon blowing in the balloon blowing group according to the SOP. Pursed lip breathing and balloon blowing were carried out for 7 days per respondent, in one day consisting of two meetings (morning and evening), one meeting consisted of three sets and in every set consisting of three cycles. The distance from each cycle is 1 minute. One cycle of training with a duration of 10 seconds, where inspiration is 4 seconds and expiration is 6 seconds, this is done for 7 days. While blowing the balloon is done once only, the patient takes a deep breath for 3 seconds, holds it for 2 seconds and then blows the balloon until the

balloon expands 5 seconds. This can be done in the morning before the respondents carried out their activities, while the afternoon was carried out when the respondents were resting after doing the activity. After doing the exercise, the next step was again to measure respiratory muscle strength, respiratory rate, oxygen saturation post-test in selected patients in the group pursed lip breathing and the group blowing balloons. All measurement results and every implementation of the procedure are documented in an observation sheet from the first day to the 7th day.

Data analysis used descriptive and bivariate analysis. Bivariate analysis to determine the effect of pursed lip breathing and balloon blowing on increasing breath muscle strength, respiratory rate, and increasing oxygen saturation (SaO2) in COPD. The analysis technique used in this study by using the alternative Wilcoxon t test in knowing the influence between independent variables and dependent variables where previously conducted normality tests and using the Mann Whitney test to test the comparison between pursed lip breathing exercise and balloon blowing on SPSS 23.0.

Results

The results of the comparison study pursed lip breathing by blowing balloons on breathing muscle strength, respiratory rate and increasing oxygen saturation can be seen in tables 1, 2 and 3. Table 1 about the PLB comparison and blowing balloons for breath muscle strength can provide information that the Wilcoxon test results showed an increase in deep breath muscle strength every day, both the group blowing the balloon and the pursed lip breathing group. The following is the value of p post intervention in each day: (1) p = 0.009, (2) p = 0.001, (3) p = 0.001, (4) p = 0.001, (5) p = 0.001, (6) p = 0.001 , (7) p = 0.001. The results of this study showed that the respiratory muscle strength of COPD patients in the group blew the balloon higher than the pursed lip breathing group. Man Whitney test results showed the effectiveness of blowing balloons on the third day post intervention with a median 5870, while the PLB with a median value of 5830. For the seventh day post intervention with a median of 5980, while the median pursed lip breathing was 5880, statistically and clinically that the balloon intervention better than the pursed intervention of lip breathing for respiratory muscle strength.

In table 2 the comparison of PLB and blowing balloons to the respiratory rate can provide information that the Wilcoxon test results show a decrease in the respiratory rate every day, both the group blowing the balloon and the pursed lip breathing group. The following are the value of p post intervention in each day: (1) p = 0.894, (2) p = 0.682, (3) p = 0.057, (4) p = 0.607, (5) p = 0.410, (6) p = 0.558 , (7) p = 0.558. The results of this study showed that the RR value of COPD patients in group blowing balloons was not different from the pursed lip breathing group. The Man Whitney test results showed the effectiveness of blowing balloons on the third day post intervention with a median of 19, while the PLB was the same as the median of 19. For the seventh day post intervention with a median of 17, the median pursed lip breathing was 17, statistically and clinically that there was no difference between the balloon blowing intervention and intervention pursed lip breathing for the respiratory rate.

In table 3 about the comparison of PLB and blowing balloons to oxygen saturation can depict information that the Wilcoxon test results showed an increase in SaO2 every day both the balloon blowing group and pursed lip breathing group. The following are the value of the post intervention in each day: (1) p = 0.579, (2) p = 0.366, (3) p = 0.240, (4) p = 0.113, (5) p = 0.272, (6) p = 0.219 , (7) p = 0.181. The results of this study showed that the SaO2 value of COPD patients in the balloon blowing group was not different from the pursed lip breathing group both on the first day to day 7. The Man Whitney test results showed the effectiveness of blowing balloons on the third day post intervention with a median of 96, while the PLB was similar to median value of 96. For the seventh day post intervention with a median of 99, so was the median pursed lip breathing of 99, statistically and clinically that there was no difference between balloon blowing intervention and intervention pursed lip breathing against SaO2.

Discussion

Comparison of Pursed Lip Breathing by Blowing Balloons on Breath Muscle Strength

The analysis's result showed that the increase in post-day breathing muscle strength for balloon blowing intervention obtained a median value of 5870 and getting higher by the end of day seventh with a median of 5980. On the other hand, the breath muscle strength for pursed lip breathing intervention on the third day post intervention was obtained a median value of 5830 and keep on increasing on the day seventh post intervention with a median value of 5880. From that comparison the value of the third day p and the seventh day is 0.001. Statistically and clinically blowing balloons is better than pursed lip breathing. In this study, the respondent's age in the pursed lip breathing group was dominated by the age of the elderly, from the early age of elderly to the late age of elderly, whereas in the group blowing the balloon the average was younger than pursed lip breathing, which varied consisting of early adults, late adults, early elderly and late elderly. Increasing age is in line with the decline in bodily functions, the thing seen in this study is the aging factor can reduce the strength of elderly breath muscles, causing a lack of increase in breathing muscle strength after performing PLB in the PLB group when compared to respondents pursed lip breathing. In the elderly there will be changes in the skeletal musculo structure of the chest that has to do with the lungs, small lungs and sagging, alveoli enlargement, bronchial hardening with increased resistance, costal cartilage calcification, rib stiffness under development conditions, loss of thoracic muscle tone, weakness of rising lung base. According to Black & Hawk (2005) the more aging a person is, the more the respiratory muscle strength is reduced and experience stiffness in the elderly. So one of the factors that influence the increase in breath muscle strength in this study is the age factor of the respondent which has an effect on the stiff and weak elderly breathing muscles which are exacerbated by COPD.

According to Stanley (2006) anatomical changes in the elderly regarding almost all anatomic structures of the body, and changes in the function of cells, tissues or organs. Anatomic changes that occur contribute to physiological changes in the respiratory system and the ability to maintain homeostasis. Anatomic changes in respiratory system due to aging are as follows: small lungs and sagging, alveoli

enlargement, decreased vital capacity, decreased PaO2 and residues, less productive mucus glands, hardening of the bronchi with increased resistance, decreased sphincter sensibility, esophageal cartilage classification, stiffness ribs under development conditions, loss of thoracic muscle tone, weakness of lung base rise, decrease in chemoreceptor sensitivity. According to Stanley (2006) in the elderly there is also respiratory muscle atrophy and decreased respiratory muscle strength. Both of these can cause lung development will not occur as it should. Thus, the client experiences a lack of O2 supply and this can lead to compensatory increase in the respiratory rate which can cause fatigue in the respiratory muscles in the elderly.

Comparison of Pursed Lip Breathing by Blowing the Balloon against the Respiratory Rate

The results showed that the decrease in respiratory rate post intervention blew the third day balloon obtained a median value of 19 and the better at the seventh day post with a median value of 17, this was similar to the pursed lip breathing intervention in the third post day the median value was 19 and the better post intervention seventh day with a median value of 17. From the above comparison obtained the third day p value of 0.057, while the seventh day p value is 0.964, thus there is a statistical and clinical difference in the third post day, which is better to blow balloons than pursed lip breathing. Nonetheless, on the seventh day there was no difference between the two interventions to decrease the respiratory rate of COPD patients. Blowing the balloon is better on the third day because in group subjects blowing balloons is influenced by age. Increasing age in the PLB group is in line with a decrease in body function so that breathing muscles experience stiffness and weakness.

According to Lewis, Dirksen, &Heitkemper (2000), Dechman& Wilson, (2004) that blowing balloons can help train the breathing muscles so as the result can improve lung ventilation function. For this study if the respiratory muscles have not been trained to the fullest, the function of pulmonary ventilation is poor, which has an effect on the speed of the respiratory rate.

There is no difference between blowing balloons and pursed lip breathing on day 4 to day 7, because in general the effects of these interventions both increase breath muscle strength which has an effect on a good respiratory rate, if it is not affected by the age of the respondent. The strong reason for each of these interventions is that pursed lip breathing serves to improve ventilation and improve the work of the abdominal and thoracic muscles (Smelzer& Bare, 2013). Breathing exercises for strong and elongated expiration such as balloon blowing and PLB will involve the strength of the intra-abdominal muscle and will increase the movement of the diaphragm up so that the thoracic cavity gets smaller. The smaller thoracic cavity causes intra-alveolar pressure to increase which exceeds atmospheric pressure. This condition will cause air to flow out of the lungs into the atmosphere. The forced and prolonged expiration during breathing with breathing exercise will reduce respiratory resistance that will facilitate air that is inhaled or exhaled. The expiration that is forced and extends will accelerate the air of inspiration and expiration, thus preventing the occurrence of water trapping in the alveoli.

A strong and longitudinal expiration will involve the strength of the intra-abdominal muscle which will also increase the upward movement of the diaphragm to make the thoracic cavity smaller (Khazanah, 2013). Similar to balloon blowing, which is blowing balloons can increase neuromuscular muscles, increase breathing muscles especially in the intercostal muscles that can improve the respiratory rate (Raju, 2015).

Comparison of Pursed Lip Breathing by Blowing Balloons on Oxygen Saturation

The results of the analysis showed that the increase in the post day third oxygen saturation for balloon blowing intervention was obtained by a median value of 96 and increased in the seventh day post intervention with a median value of 99, while the pursed lip breathing intervention for the third day post intervention obtained a median value of 97 and increased too in post intervention seventh day with a median value of 99.00. From the comparison above, the value of p = 0.240 is obtained on the third day and on the seventh day the value of p = 1.181. Statistically and clinically, there was no difference between pursed lip breathing and balloon blowing. This is because at the beginning of the PLB intervention and blowing balloons, these two interventions can train the strength of the breathing muscles, especially in the intercostal muscles that can resulted in the improvement of the respiratory rate specifically for balloon blowing, while the PLB and blowing balloons focus on exercising the expiratory muscles to extend exhalation and increase airway pressure during expiration, thereby reducing the number of pressure and air trapping (air trapping), this can increase oxygen in the lungs as much as possible, thus the oxygen saturation in the blood increases and reduces the buildup of carbon dioxide in the blood.

Efforts to prolong expiration will prevent air from being exhaled spontaneously which can result in pulmonary collapse or collapse, thus breathing PLB and blowing balloons help expel the trapped air in COPD patients so that the CO2 in the lungs can be removed. Expending CO2 from the lungs provides an opportunity for O2 to fill the alveolar space even more. Increased gas exchange in patients who blow balloons and PLB so that oxygen that moves to the pulmonary capillary will increase and the CO2 released to the alveoli will increase. Increasing the amount of oxygen that moves to the pulmonary capillary will increase the amount of oxygen bound by the Hb.

Balloon blowing and PLB exercises will increase the O2 pressure in the alveolus compared to O2 pressure in the pulmonary capillary and the low CO2 pressure in the alveolus compared to the high CO2 pressure in the pulmonary capillary causing an increase in the pressure gradient between the two sides. The high difference in O2 pressure gradient increases gas exchange, namely the diffusion of O2 from the alveolus to the pulmonary capillary. The high difference in CO2 pressure also increases gas exchange, namely diffusion of CO2 from the pulmonary capillaries to the alveoli to then be released into the atmosphere. Sherwood, L. (2014).

In addition, the diffusion process is influenced also by the respondent's height. Someone who taller tend to have a higher vital lung capacity in comparison to

those who quite short and fat. Respondents who have the ideal height can increase the compliance of the chest wall and lungs so that ventilation of the lungs will run smoothly, this can increase vital lung capacity. In addition, respondents who have normal nutritional status have adequate nutrition for body metabolism and will be able to quickly repair lung cells (Supariasa, I Dewa Nyoman 2002). In this study there were 67% of respondents who had ideal height in both the PLB group and the group blowing balloons, so that after the balloon blowing intervention and PLB in each of these groups there was a significant increase in SaO2 every day. This may be happened because there is no difference in the number of respondents who have the ideal height between the PLB group and the balloon blowing group. It shows that there is no difference between the increase in SaO2 in the group blowing balloons and the PLB group. According to Guyton & Hall (2001) that height is not directly related to the occurrence of COPD or COPD recurrence. However, height is related to lung anatomy, specifically the lung surface area.

Conclusion

Blowing balloons is very significant in increasing breath muscle strength when compared to pursed lip breathing in COPD patients. This increase in breath muscle strength and significance difference was seen on the first day until the seventh day after the intervention. But there is no difference between blowing balloons and the pursed lip breathing against decreasing respiratory rate and increasing oxygen saturation in COPD patients.

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