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EXERCISE THERAPY PROGRAM IN SECONDARY SPONTANEOUS PNEUMOTHORAX ASSOCIATED WITH PULMONARY TUBERCULOSIS: A CASE REPORT

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Abstract

Introduction: Secondary spontaneous pneumothorax (PSS) occurs due to underlying lung disease, in some developing countries pulmonary tuberculosis (TB) is the primary cause of PSS.
Case Presentation: A 37 years-old male patient who was farmer from Wonogiri, Central Java, came to RS Paru Dungus with the symptoms of dyspnea, cough, and chest pain for 3 months ago. The patient is an active smoker for 25 years and quits smoking 3 months ago. The patient has a history of pulmonary TB disease. On examination of vital signs, blood pressure and heart rate were good, the patient's breathing was 28x/minute, oxygen saturation was 90%. A chest X-ray showed suggestive pleural TB with secondary infection and pneumothorax in the left apical segment. Based on the inspection, the patient using diaphragmatic breathing, has a barrel chest, and kyphosis. On palpation, there was a spasm of the accessory muscles of respiration. Auscultation showed normal breath sounds and hyper resonance in the left superior area. Vocal fremitus in left superior lobe > left inferior lobe. The dyspnea scale was 6 while the functional activity examination showed the patient was on a scale of 4.
Management and Outcome: Physiotherapists give breathing control (BC), deep breathing exercise (DBE), and chest expansion resistance exercise (CERE) training programs for 9 days, getting the results of decreasing dyspnea level and increasing the patient's functional activity.
Discussion: Pneumothorax secondary to TB usually occurs after extensive TB involvement of the lung as sudden bronchopleural fistulization and empyema with severe cavitary formations cause pleural rupture. BC is given to patients with a respiratory rate >20x/min, to help improve inefficient or abnormal breathing patterns, while DBE can increase ventilation and oxygenation, and CERE is given to maximize lung expansion by increasing the amount of air that can be pumped by the lungs to maintain the performance of the respiratory accessory muscles.
Conclusion: Exercise therapy can reduce shortness of breath and improve functional activity in patients with secondary spontaneous pneumothorax associated pulmonary TB.

Keywords : secondary spontaneous pneumothorax, pulmonary TB, exercise therapy, physical therapy

Introduction

Pneumothorax is defined as the presence of air in the pleural cavity caused by an accumulation of air between the parietal and visceral pleura. The accumulation increases the pressure of the lungs and eventually, it can cause collapse (McKnight, *et al*., 2020). Pneumothorax is divided into spontaneous and traumatic. Traumatic pneumothorax occurs due to traumatic injury. A primary spontaneous pneumothorax (PSP) occurs without underlying lung disease, while secondary spontaneous pneumothorax (SSP) occurs as a complication of underlying lung disease, most frequently a consequence of chronic obstructive pulmonary disease (COPD) or pulmonary tuberculosis (Onuki *et al*., 2017). In some developing countries, pulmonary tuberculosis (TB) is the leading cause of SSP. Secondary spontaneous pneumothorax associated with TB can occur in case of residual fibrosis with retraction of bullae (Briones-Claudett, *et al*., 2020).

The annual incidence of spontaneous pneumothorax is 18-28 cases and 1.2-6 cases per 100,000 men and women. Meanwhile, the incidence of primary spontaneous pneumothorax was 7.4-18 and 1.2-6 cases per 100,000 population, respectively, and secondary spontaneous pneumothorax was around 6.3 and 2 cases per 100,000 males and females (Onuki *et al*., 2017). The estimated incidence of spontaneous pneumothorax associated with active TB is 1-2% cases of pneumothorax, some others are associated with other pulmonary infections, such as pneumonia and pneumonia bacterial in acquired immunodeficiency syndrome (AIDS) (Briones-Claudett, *et al*., 2020).

The incidence may be related to air pollution, changes in atmospheric pressure, smoking habits, rapid changes of body structure related to obesity, and genetic factors. There is a relationship between the incidence of spontaneous pneumothorax with gender, age, and comorbidities. Spontaneous pneumothorax is more common in men than women (Pwidjaya et al., 2014). SSP was significantly more common in TB patients <38 years old (Singh, *et al*., 2017).

In the study by Shamaei *et al.*, (2011) the most common symptoms were cough, dyspnea, sweating, fever, sputum, pleuritic chest pain, and weight/appetite loss. To reduce the symptoms that occur in patients with pneumothorax, some exercise therapy or breathing exercises will be given to these patients, such as breathing control, deep breathing exercise, and chest expansion resistance exercise (CERE). Here we report the case of a patient with secondary spontaneous pneumothorax associated with tuberculosis.

Case Presentation

A 37 years-old male patient who was a farmer from Wonogiri, Central Java who came to Dungus Pulmonary Hospital, due to dyspnea (shortness of breath), cough, and chest pain from 3

months ago. The patient previously had been treated in another hospital for 5 days and getting improvement, after a week he relapsed again. The patient reported that at night or when it was cold, even during strenuous activities, the coughing and dyspnea increased. In addition, when there is a change in sleeping position, sitting, and supine without a pillow, the dyspnea increases. The dyspnea level getting better when the patient is in a half-lying position.

Previously, the patient was an active smoker who could spend one pack a day, he had smoked for 25 years and just quit smoking 3 months ago. He also had a history of pulmonary tuberculosis. On physical examination, the patient appears weak. The patient presented the following vital signs: blood pressure 120/90 mmHg, heart rate (HR) 90x/minute, respiratory rate (RR) 28x/minute, and the oxygen saturation (SpO2) 90%. A chest X-ray showed a reticulo granular pattern diffuse in both sides of the lung, avascular lucent area in left hemithorax; suggestive pleural TB with secondary infection and left apical pneumothorax.

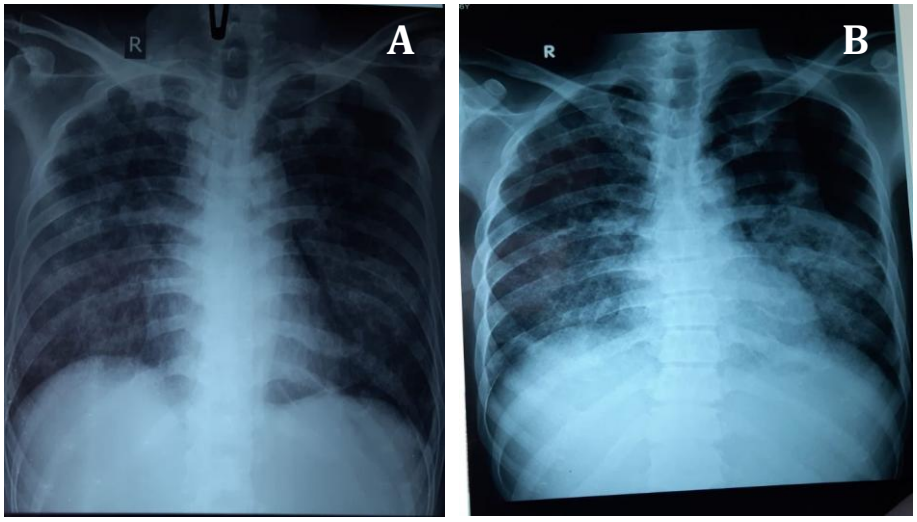

Figure 1. Chest X-ray images A) 06 Jan 2021 and B) 09 Jan 2021, showed pleural TB with secondary infection and left apical pneumothorax but there is an increase in the left apical pneumothorax in fig. B

The patient remained in the lung treatment ward with infusion and nasal cannula. He uses diaphragmatic breathing, has a barrel chest, and kyphosis. From palpation, we get the presence of spasms in the accessory respiratory muscles: m. sternocleidomastoideus, m. scalenus, m. upper trapezius, m. pectoralis major, and m. serratus anterior.

Auscultation showed normal breath sounds and hyper resonance in the left superior area. The vocal fremitus in the left superior lobe has a greater vibration than the left inferior lobe. We examine the shortness of breath using the borg scale, the score is 6 which means heavy breath. Based on the medical research council (MRC) dyspnea scale obtain the patient's functional activity is on a scale of 4 which has shortness of breath in light daily activities (bathing and dressing).

Management and Outcome

The patient's symptoms were shortness of breath, cough, and chest pain from 3 months ago. The physiotherapist planned a 9-day exercise program, were: breathing control (BC), deep breathing exercise (DBE), and CERE while the patient was hospitalized. The results of the physiotherapy program given to the patient can be seen in figure 2 for the evaluation of the dyspnea examination by the borg scale and the results for the patient's functional activity in figure 3.

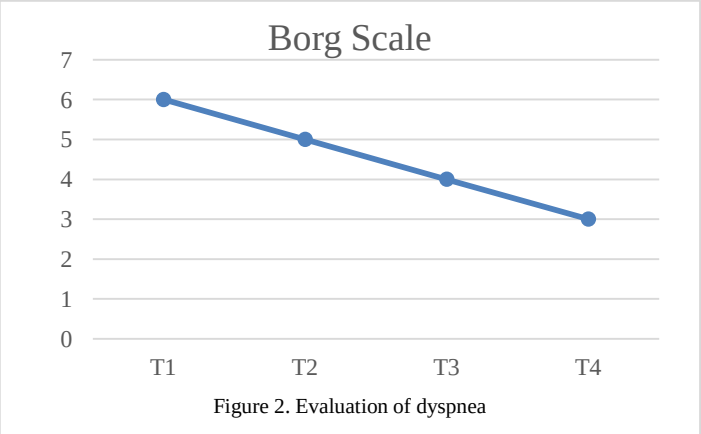

Figure 2. Evaluation of dyspnea

The picture above is the result of the evaluation of the examination during four times exercises for the patient. The patient's shortness of breath decreased from a scale of 6 (severe shortness of breath) until it gradually decreased to the last evaluation on a scale of 3 (mild shortness of breath).

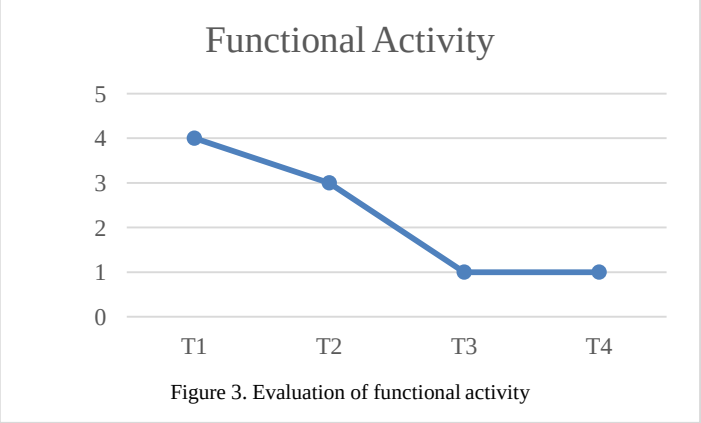

Figure 3. Evaluation of functional activity

The results of the evaluation of functional activity examinations using the medical research council (MRC) dyspnea scale during four routine exercise programs. It shows that the curve decrease, while the results of this evaluation decline it means the patient's condition is better. The initial score on the examination is 4, which means shortness of breath when doing light daily

activities (bathing and dressing). It gradually increases to a score of 1 with shortness of breath when walking upstairs.

Discussion

A secondary spontaneous pneumothorax due to an infection can be life-threatening because of the patient's underlying respiratory disease. Pneumothorax secondary to TB usually occurs after extensive TB involvement of the lung as sudden bronchopleural fistulization and empyema with severe cavitary formations or may also with miliary TB. The organism of TB invades pleura and causes pleural rupture (Shamaei, *et al*., 2011). Cavities appear when large granulomas with central liquefaction and erosions with the discharge of their contents in the underlying airway are produced (Briones-caudet, *et al*., 2020).

Dyspnea, chest pain, cough, and fever were the clinical features in the patient of SSP on admission in the study done by Singh *et al*, (2017). Our finding of radiological manifestation in this patient was in concordance with Singh *et al*, (2017) that showed cavitation and the pattern of pneumothorax is in the left side as the most frequent finding in the patient of SSP.

The exercise therapy program is given to reduce the symptoms that appear in a patient was breathing control, deep breathing exercise, and chest expansion resistance exercise. The patient came with a respiratory rate of 28x/minute. BC is given to patients with a respiratory rate >20x/min, to help improve inefficient or abnormal breathing patterns. In addition, BC can help the respiratory muscles relaxed, reduce shortness of breath, and improve ventilation at the base of the lungs (Thomas, 2014).

Patients performing breathing control by controlling breathing patterns so that they can cope with sudden shortness of breath and reduce how often it occurs. When using this technique, the patient may be instructed to sit on the bed, then asked to inhale and exhale gently and regularly through the nose and exhale through the mouth. Try to close your eyes and focus on breathing and relaxing which is repeated 3-5 times. The physiotherapist's hand is placed on the back to feel the up and down movement when breathing (Huriah *et al*., 2017).

Deep breathing exercise (DBE) is an exercise technique by taking deep breaths and exhaling slowly (Smeltzer *et al*., 2008) to increase ventilation and oxygenation. Priyanto *et al*. (2011) stated that DBE has a positive effect in increasing the ability of the inspiratory muscles. Inhaling and exhaling slowly and deeply is one of the controlled activities between the respiratory center control and the respiratory muscles.

In addition, according Busch *et al* (2011), muscle tension and anxiety can stimulate pain so that DBE can be done to reduce pain because it has the effect of muscle relaxation. Deep breathing

relaxation techniques can overcome pain based on the theory of reticular activation, which inhibits the painful stimulus when a person receives sufficient or excessive sensory input, causing the inhibition of pain impulses to the brain so that pain is reduced or no pain (Hamarno *et al*., 2017).

Patients performing DBE with half lying by the hand under the abdomen to feel the movement of the chest and abdomen when breathing. Then the patient is asked to take a deep breath through the nose, then hold for 2 seconds, and exhale through the lips while relaxing the abdominal muscles.

Chest expansion resistance exercise is one of the breathing exercises based on proprioceptive neuromuscular (Kim et al., 2015). This CERE is given to patients with pneumothorax because the lungs cannot expand properly. This exercise aims to maximize lung expansion by increasing the amount of air that can be pumped by the lungs to maintain the performance of the respiratory accessory muscles which can later reduce clinical symptoms such as shortness of breath (Song *et al*., 2015). In addition, CERE is an exercise that can be used to balance the strength of the respiratory muscles with the rhythm of breathing, combine deep breathing with active movement of the trunk and limbs, with resistance to the sternum and ribs during inspiration. This exercise can also be used to relax the respiratory muscles and mobility of the thorax (Kido *et al*., 2013).

CERE is performed with the patient side-lying then the therapist places hands on the anterior and posterior thorax. When the patient initiates inspiration after exhaling, the therapist applies resistance to the coccygeal vertebra over the palpated area. The therapist instructs the patient to exhale slowly. The exercise is carried out in 10 sets, 15 repetitions/set, with 30 seconds of rest (Kim *et al*., 2015).

Conclusion

We reported the case of a 37-year-old-man with a history of pulmonary tuberculosis and being an active smoker for 25 years who come to our hospital due to dyspnea, cough, and chest pain for 3 months. Radiological features show that there is cavity formation in secondary spontaneous pneumothorax, then the lung expansion to decreases and causes the patient to feel short of breath/ dyspnea. The patient is given an exercise therapy program as breathing control, deep breathing exercise, and chest expansion resistance exercise for 4x treatment, so it has been reducing dyspnea and increasing activity tolerance of the patient.

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