CASE REPORT

Physical Medicine and Rehabilitation Management in Patient with Loculated Empyema, Pleural Effusion et causa Chylothorax on WSD, Gastrointestinal Tuberculosis and History of Drop-Out Pulmonary Tuberculosis: A Case Report

Tresia Fransiska[1], Astrid Meilinda[2], Nasya Marisyka Putri[2], Carissa Putri Crisdayani[1], Adinda Aotearoa Afta[1]

[1] Departement of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Indonesia,, University of Indonesia Hospital, Jakarta, Indonesia

[2] Departement of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jakarta, Indonesia

ABSTRACT

Introduction: Tuberculosis (TB) is an infectious disease that can cause infections in the lungs and other tissues or organs. It is caused by Mycobacterium tuberculosis (MTB) infection, which can affect both pulmonary and extra-pulmonary sites. While tuberculosis incidence is declining, the complexity of TB cases is increasing.

Case report: A 52-year-old man presented with a chief complaint of worsening abdominal pain that had persisted for four weeks prior to hospitalization at dr. Cipto Mangunkusumo Hospital. He had a history of tuberculosis 20 years ago but discontinued medication after three months. Physical examination revealed tenderness in the right lower quadrant of the abdomen. Laboratory examination showed leukocytosis and thrombocytosis. X-ray examination revealed loculated pleural effusion, while a CT scan of the abdomen showed irregular thickening of the cecum wall and part of the large intestine, along with multiple surrounding lymphadenopathies. A Water-Sealed Drainage (WSD) was performed, and pleural fluid analysis revealed chylus. The patient was diagnosed with gastrointestinal TB and received category 1 anti-tuberculosis drug treatment. Additionally, the patient underwent pulmonary rehabilitation, including deep breathing exercises, inspiratory muscle training with incentive spirometry, and cardiorespiratory endurance exercises. After 10 days of pulmonary rehabilitation, the patient was reassessed and showed improved lung functional capacity with a VO2max of 10.59 and METs of 3.02. The sit-to-stand test yielded a score of 13, and there was an increase in inspiratory capacity by 1500 mL.

Conclusion: It is crucial to initiate pulmonary rehabilitation programs early in hospitalized patients with respiratory disorders to prevent further functional deterioration and enhance overall improvement in functional capacity.

Keyword: empyema, tuberculosis, 6-minute walk test, sit to stand test, inspiratory capacity

ABSTRAK

Pendahuluan: Tuberkulosis (TB) merupakan penyakit menular yang dapat menyebabkan infeksi pada paru-paru dan jaringan atau organ lain. Infeksi ini disebabkan oleh Mycobacterium tuberculosis (MTB), yang dapat menyerang organ paru-paru dan organ selain paru-paru, yang disebut TB ekstra paru. Insiden tuberkulosis menurun tetapi komplikasi kasus TB terus meningkat.

Laporan kasus: Seorang laki-laki berusia 52 tahun datang dengan keluhan utama nyeri perut yang bertambah berat dalam empat minggu sebelum masuk rumah sakit dr. Cipto Mangunkusumo. Pasien memiliki riwayat penyakit TBC pada 20 tahun yang lalu, tetapi hanya pengobatan selama 3 bulan. Pada pemeriksaan fisik didapatkan nyeri tekan pada abdomen kuadran kanan bawah. Hasil laboratorium menunjukan leukositosis dan trombositosis. Pemeriksaan X-ray ditemukan adanya loculated efusi pleura. CT Scan abdomen menunjukkan penebalan dinding sekum yang tidak teratur pada bagian usus besar dan limfadenopati multipel di sekitarnya. Pada hasil pemasangan Water sealed drainage (WSD) dan hasil analisis cairan pleura didapatkan chylus. Pasien didiagnosis TB gastrointestinal dan diberikan pengobatan obat anti tuberkulosis kategori 1 serta menjalani rehabilitasi paru dengan latihan nafas dalam, pelatihan otot inspirasi dengan spirometri insentif dan daya tahan kardiorespirasi. Setelah 10 hari rehabilitasi paru, Pemeriksaan ulang dilakukan dan didapatkan peningkatan kapasitas fungsional paru dengan VO2max 10,59 dan METs 3,02, sit to stand test 13 serta peningkatan kapasitas inspirasi 1500 mL. Kesimpulan: Program rehabilitasi paru harus diberikan sedini mungkin pada pasien rawat inap dengan gangguan pernapasan untuk mencegah kerusakan lebih lanjut pada fungsinya sehingga dapat membantu meningkatkan kapasitas fungsional.

Kesimpulan: Program rehabilitasi paru harus diberikan sedini mungkin pada pasien rawat inap dengan gangguan pernapasan untuk mencegah kerusakan lebih lanjut pada fungsinya sehingga dapat membantu meningkatkan kapasitas fungsional.

Keyword: Emfisema, tuberculosis, uji jalan 6 menit, sit to stand, kapasitas inspirasi

Correspondent Detail:

Tresia Fransiska

Departement of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Indonesia,, University of Indonesia Hospital, Jakarta, Indonesia
Email: fransiska_ut@yahoo.com.au

INTRODUCTION

Tuberculosis (TB) is a significant global health problem. According to the World Health Organization (WHO), an estimated 10.4 million TB cases and 1.67 million deaths occurred due to TB in 2017. The WHO Global TB Report 2020 states that 10 million people worldwide have tuberculosis, and 1.2 million people succumb to the disease annually. Indonesia, with an estimated 845,000 cases and a death rate of 98,000, equivalent to 11 fatalities per hour, faces one of the highest TB burdens globally (WHO Global

TB Report, 2020). Unfortunately, only 67% of these cases were diagnosed and treated,leaving 283,000 cases untreated and posing a risk of disease transmission to others.[1]

TB is caused by infection with Mycobacterium tuberculosis (MTB), which primarily affects the lungs but can also target organs outside the lungs, referred to as extrapulmonary TB. Of the 6.3 million new TB cases, proportion of extrapulmonary TB from TB new cases were 16%.[2] Extrapulmonary TB can occur in the abdominal organs, meninges, genitourinary tract, joints, bones, and lymph nodes.[3] Chylothorax is caused by extravasation of chyle in the pleural space due to obstruction or injury thoracic duct or transdiaphragmatic outflow from the peritoneal cavity. Chylothorax is categorized as traumatic or non-traumatic. The initial treatment for chylothorax involves inserting a tube into the 7th intercostal space and confirming its placement through chest X-ray examination to ensure proper positioning.

The chest tube is typically left in place until X-rays indicate complete drainage of blood, fluid, or air from the chest, and full re-expansion of the lung. Removal of the tube is easy when it is no longer needed.[4] Some pleural complications, such as TB pleural effusion, hemothorax, and empyema, can result in pachypleuritis during the healing process, which may impede lung expansion during expiration. Patients with chronic pleural involvement may experience impaired breathing, thoracic pain, and changes in breathing patterns. Over time, these patients may develop restrictive ventilatory dysfunction, leading to reduced quality of life due to breathlessness and limited mobility. Pulmonary rehabilitation can help improve dyspnea, alleviate symptoms, minimize lung function impairment, and enhance overall quality of life in patients with acute pleural effusion.[5]

In this case, a male patient was referred to the medical rehabilitation department with complaints of dyspnea and cough that was difficult to be expelled. Management of pulmonary rehabilitation such as active cycle breathing, deep breathing exercise, inspiratory muscle training and endurance cardiorespiratory can provide significant benefit for patients with restrictive lung disorders due to loculated empyema and pleural effusion caused by chylothorax on WSD. Therefore, this case presents an interesting opportunity for further discussion.

CASE PRESENTATION

A 52-year-old male patient was referred to the Physical Medicine and Rehabilitation Department on April 4th, 2022, with complaints of phlegmonous cough that was difficult to be expelled and dyspnea. The patient initially presented to the emergency room of Dr. Cipto Mangunkusumo Hospital on March 23rd, 2022, with chief complaint of severe abdominal pain persisting for 3 weeks before being admitted to the hospital. The Abdominal pain was intermittent with a VAS score of 4. No complaints of nausea or vomiting. One month before admission, the patient experienced symptoms of productive productive cough, fluctuating fever, night sweats, and a weight loss of 7 kgs. There was no history of chest trauma. One week prior to admission, the patient reported passing blackish liquid stools twice a day. During the course of treatment, the patient was diagnosed with left pleural effusion caused by chylothorax, necessitating the

insertion of a chest tube connected to the Water-Sealed Drainage (WSD) system in the left lung. One year ago, the patient had a history of high platelet counts, but the cause was unknown. No follow-up examination records were found at the hospital. Additionally, the patient had a history of pulmonary tuberculosis (TB) 20 years ago but discontinued medication after three months. There is a 20-year history of smoking 1.5 packs per day. The patient is employed as a security guard, primarily working night shifts.

On physical examination, the patient was conscious with a blood pressure of 145/90 mmHg, a pulse rate of 89 beats per minute, a respiratory rate of 23 breaths per minute, and an oxygen saturation of 98% on room air. The patient had a height of 150 cm, a weight of 48.2 kg, and a BMI of 21.42. Respiratory status assessment revealed symmetrical lung expansion and no use of accessory breathing muscles. Upon palpation, weakened fremitus was noted on the left side, and chest expansion was measured at 2-3.5-4 cm. Percussion indicated a resonant sound in the right lung field and a dull sound in the left lung. Auscultation revealed weakened vesicular sounds in the left lung, without crackles or wheezing. There was minimal phlegm present in both lungs. A Water-Sealed Drainage (WSD) system was installed, with a production of 40 ml/24 hours, showing hemopurulent characteristics and presence of undulation, but no bubbling. The patient remained stable while transitioning to a sitting position at a 90-degree angle from supine. There were no subjective symptoms, and the patient was hemodynamically stable. However, when moving to sit on the edge of the bed, the patient reported subjective complaints of dizziness, with a blood pressure of 135/80, a pulse rate of 88 beats per minute, and an SpO_2 of 98% on room air. The Barthel index score was 80, indicating mild dependence. The Single Breath Counting Test (SBCT) yielded a score of 21.

Hemoglobin levels were 14.8 g/dL, hematocrit was 45.5%, erythrocytes were 5.9x106/uL, platelets were 1,856,000/uL, and leukocytes were 26,330/uL. PT was 12.1 sec (10.9), APTT was 41.8 sec (32.7), fibrinogen was 242.2 mg/dL, and d-Dimer was 1500 ug/L.

Regarding analysis of the pleural fluid with chyle impression, a chest X-ray examination conducted on March 23rd, 2022, showed homogeneous opaqueness with calcification in the left hemithorax and a loculated pleural effusion. Chest X-Ray on 24th March 2022 suggested misdiagnosis of calcification in the left hemothorax to a suspected loculated pleural effusion. The impression was slightly reduced. A slightly increased impression on a similar chest Xray results on 30th March 2022 was also observed.

A 52-year-old male patient was referred to the Physical Medicine and Rehabilitation Department on April 4th, 2022, with complaints of phlegmonous cough that was difficult to be expelled and dyspnea. The patient initially presented to the emergency room of Dr. Cipto Mangunkusumo Hospital on March 23rd, 2022, with chief complaint of severe abdominal pain persisting for 3 weeks before being admitted to the hospital. The Abdominal pain was intermittent with a VAS score of 4. No complaints of nausea or vomiting. One month before admission, the patient experienced symptoms of productive productive cough, fluctuating fever, night

sweats, and a weight loss of 7 kgs. There was no history of chest trauma. One week prior to admission, the patient reported passing blackish liquid stools twice a day. During the course of treatment, the patient was diagnosed with left pleural effusion caused by chylothorax, necessitating the insertion of a chest tube connected to the Water-Sealed Drainage (WSD) system in the left lung. One year ago, the patient had a history of high platelet counts, but the cause was unknown. No follow-up examination records were found at the hospital. Additionally, the patient had a history of pulmonary tuberculosis (TB) 20 years ago but discontinued medication after three months. There is a 20-year history of smoking 1.5 packs per day. The patient is employed as a security guard, primarily working night shifts.On physical examination, the patient was conscious with a blood pressure of 145/90 mmHg, a pulse rate of 89 beats per minute, a respiratory rate of 23 breaths per minute, and an oxygen saturation of 98% on room air. The patient had a height of 150 cm, a weight of 48.2 kg, and a BMI of 21.42. Respiratory status assessment revealed symmetrical lung expansion and no use of accessory breathing muscles. Upon palpation, weakened fremitus was noted on the left side, and chest expansion was measured at 2-3.5-4 cm. Percussion indicated a resonant sound in the right lung field and a dull sound in the left lung. Auscultation revealed weakened vesicular sounds in the left lung, without crackles or wheezing. There was minimal phlegm present in both lungs. A Water-Sealed Drainage (WSD) system was installed, with a production of 40 ml/24 hours, showing hemopurulent characteristics and presence of undulation, but no bubbling. The patient remained stable while transitioning to a sitting position at a 90-degree angle from supine. There were no subjective symptoms, and the patient was hemodynamically stable. However, when moving to sit on the edge of the bed, the patient reported subjective complaints of dizziness, with a blood pressure of 135/80, a pulse rate of 88 beats per minute, and an SpO2 of 98% on room air. The Barthel index score was 80, indicating mild dependence. The Single Breath Counting Test (SBCT) yielded a score of 21.

Hemoglobin levels were 14.8 g/dL, hematocrit was 45.5%, erythrocytes were 5.9x106/uL, platelets were 1,856,000/uL, and leukocytes were 26,330/uL. PT was 12.1 sec (10.9), APTT was 41.8 sec (32.7), fibrinogen was 242.2 mg/dL, and d-Dimer was 1500 ug/L.

Regarding analysis of the pleural fluid with chyle impression, a chest X-ray examination conducted on March 23rd, 2022, showed homogeneous opaqueness with calcification in the left hemithorax and a loculated pleural effusion. Chest X-Ray on 24th March 2022 suggested misdiagnosis of calcification in the left hemothorax to a suspected loculated pleural effusion. The impression was slightly reduced. A slightly increased impression on a similar chest Xray results on 30th March 2022 was also observed.

Picture 1. Comparison of chest X-ray on March 23rd 2022 – March 24th 2022 – March

CT scan of the abdomen with contrast on March 23rd, 2022 showed irregular thickening of the caecum wall extending to a portion of the large intestine measuring 8.2 cm, accompanied by fat stranding and multiple surrounding lymphadenopathy, intestinal DD/TB, perforated appendicitis, loculated effusion with thickened walls and calcification in the left hemithorax, DD/tuberculous empyema, fibrosis with consolidation at the base of the left lung, DD/ pulmonary tuberculosis, multiple paraaortic lymphadenopathy, minimal ascites in the pelvic cavity, right nephrolithiasis, prostate calcification, and right pleural effusion.

The patient received category 1 anti-tuberculosis drug treatment and commenced pulmonary rehabilitation. The physiatrist and rehabilitation team provided breathing exercises, chest expansion, and the active cycle breathing technique (ACBT) three times a day, with each exercise consisting of five repetitions. The initial inspiratory capacity measured using incentive spirometry was 1000mL. Consequently, incentive spirometry exercises were initiated with a moderate intensity of 60% five times a day, three sets of five repetitions, with two-minute intervals. The patient mobilized by walking around the hospital room and stop exercising when the Borg scale indicated a score of 13-4-4.

On the third day of the rehabilitation program, the patient experienced less shortness of breath and cough. The patient's blood pressure was 139/80 mmHg with a pulse of 78 times per minute, a respiratory rate of 18 breaths per minute, and an oxygen saturation of 98% in room air. There was 10 ml/24 hours of WSD production, hematopurulent and undulation was present. Chest expansion measured 2.5 - 4 - 5 cm. The patient performed incentive spirometry exercises without resistance, achieving a volume of 600 mL.

Figure 2. Incentive spirometry

The patient reported subjective dizziness upon changing positions from sitting to standing, accompanied by a decrease in systolic blood pressure by 21 mmHg. Subsequently, the patient was diagnosed with orthostatic hypotension and received additional information on managing this condition, including gradually changing positions, maintaining an upright posture, and engaging in mobilization activities.

Figure 3. Six minutes walking test

On the fifth day of the rehabilitation program, the patient had no complaints and maintained stable hemodynamics. His inspiratory capacity remained unchanged, and he was able to perform sit-to-stand exercises 10 times without any subjective complaints. A 6-minute walk test was conducted, yielding a distance of 262.5 meters, a VO2max of 9.66, and 2.76 METS. The predicted walking distance for the patient was 585 meters, indicating low cardiorespiratory endurance. Based on the classification of cardiorespiratory fitness for men, determined by the distance covered in a six-minute walk test, the patient fell into the very low category. After the walking test, the patient remained hemodynamically stable.

An additional program was implemented, involving 200-meter walking mobilization around the hospital room. The exercise was discontinued when the Borg scale reached 13-4-4. Additionally, sit-to-stand exercises were incorporated into the regimen, to be performed twice a day with 10 repetitions in each cycle.

The evaluation of the rehabilitation program on the ninth day showed that the patient had stable hemodynamics. The WSD was removed, and the chest expansion measured 3 - 4.5 - 5.5 cm. The inspiratory capacity improved to 1500 mL. Due to this improvement, the intensity of the incentive spirometry exercise was increased to a moderate level (60%) five times a day, with 3 sets of 10 repetitions and 2-minute intervals. The patient performed the sit-to-stand exercise 12 times. Additionally, the patient was able to walk around a 200-meter hallway without any complaints. The rehabilitation program was continued.

In the final evaluation of the rehabilitation program before the patient's discharge, several outcome assessments were conducted. The patient performed the sit-to-stand test 13 times and achieved a distance of 280 meters in the 6-minute walk test. The patient's VO2max was measured at 10.59, and the METs reached 3.02. The patient was prescribed an aerobic exercise program to be performed at home, with a frequency of 3-5 times a week. The exercise should be of moderate intensity (50-60%) with a reserved HR of 121-130 beats per minute. The exercise program must include a 30-minute walking session. Informed consent has been obtained from the patient.

DISCUSSION

Tuberculosis primarily affects the lungs, although it can also impact other organs and tissues. Extra-pulmonary forms of TB often go unnoticed or are diagnosed late. A chylothorax, also known as chylous pleural effusion, is an uncommon cause of pleural effusion with a wide differential diagnosis characterized by the accumulation of bacteriostatic chyle in the pleural space. Chylothorax, as an uncommon manifestation of extra-pulmonary TB, is most frequently observed in developing countries where infectious diseases like TB prevail. Several mechanisms have been identified for the development of chylothorax in TB, including: (1) mediastinal adenopathy with occlusion or erosion into the thoracic duct and leakage of chyle into the pleural space, (2) abdominal lymphadenopathy with occlusion of the cisterna chyli and opening of lymphaticovenous anastomosis, and (3) constrictive pericarditis associated with elevated left subclavian venous pressures leading to increased production and reduced drainage of lymph.[7]

Normal intrapleural pressure is -5 cmH2O. During inspiration, the chest wall expands, allowing the lung to expand and air to flow inward. During expiration, the intrapleural pressure decreases to approximately -4 cmH2O, enabling air to flow from the lung to the atmosphere. The negative pressure in the pleural space keeps the lungs expanded and counteracts the tendency of lung tissues to recoil elastically, preventing collapse. However, if air or fluid enters the pleural space, the negative pressure is lost, and the affected lung may partially or fully collapse.[8]

People with a history of untreated or inadequately treated pulmonary TB have a higher risk of reactivation TB.9 Without proper treatment, TB exhibits characteristic of chronic inflammation and carries a mortality rate of 50% within five years. Even after completing treatment for pulmonary TB, approximately two-thirds of patients experience pulmonary function abnormalities, with obstructive defect being the primary abnormality. Tuberculosis serves as an independent risk factor for developing COPD, and its impact persists for at least six years following TB diagnosis. Tuberculosis is characterized by chronic caseous granulomatous inflammation, which can lead to severe tissue damage if left untreated. In a nationwide survey conducted in South Africa, the strongest predictor of COPD was a history of pulmonary TB, with odds ratios (OR) of 4.9 (95% CI 2.6–9.20) for males and 6.6 (95% CI 3.7–11.9) for females.[10]

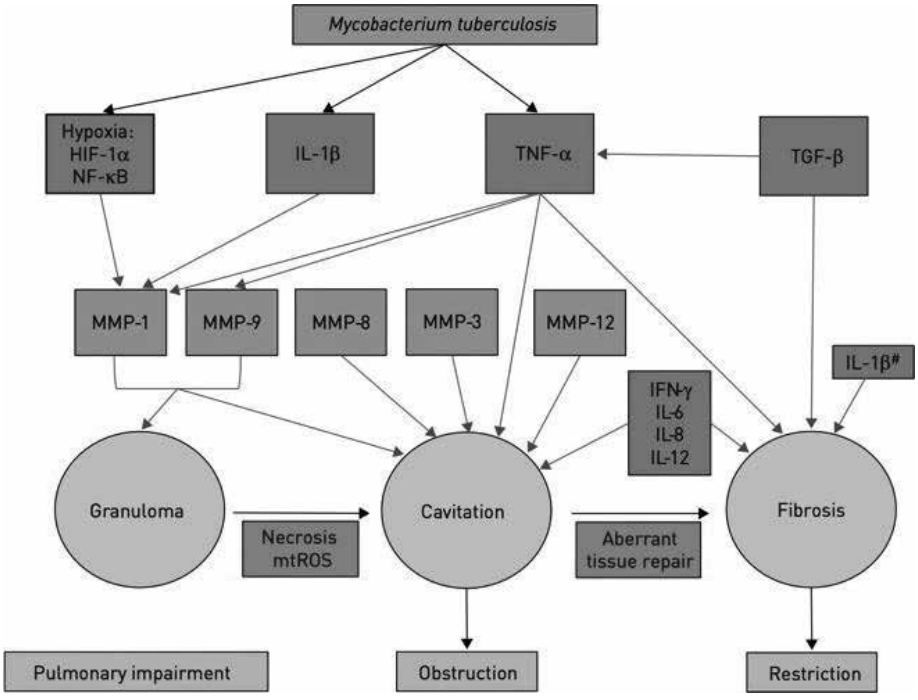

Figure 4. Immune mediators of tissue remodelling and lung function impairment intuberculosis11

Different complications can occur after TB, which can be categorized as follows: (1) Parenchymal lesions, (2) airway lesions, (3) vasculature lesions, (4) pleural lesions, and (5) general lesions.12 Pleural lesions include empyema, which is a suppurative infection of the pleural space. In the developing countries, tuberculosis remains the common cause of empyema. The development of empyema takes 3-6 weeks and has been divided into three stages: the exudative stage (stage I), the fibro-purulent and loculated stage (stage II), and the chronic, organizing, cortical stage (stage III).13 Fibrin forms a thick peel, eventually leading to a reduction in hemithorax volume and possible erosion either into the tracheobronchial tree or through the chest wall. Prompt treatment allows for effective management of the infected pleural space through tube thoracostomy, antibiotic therapy, fibrinolytics, or surgery.

Reactive thrombocytosis often occurs in many chronic inflammatory diseases, including tuberculosis. It has been found that 75% of patients with tuberculosis have thrombocytosis. The exact mechanism of elevated thrombopoietin levels in reactive thrombocytosis is still unknown; however, it has been observed to be correlated with inflammatory processes. The concentration of serum IL-6 is significantly correlated with the thrombocyte count. IL-6 may play a contributory role in reactive thrombocytosis and the acute phase response in pulmonary tuberculosis.

Pulmonary rehabilitation has been used to treat diseases such as asthma, cystic fibrosis, interstitial lung disease (ILD), obesity-related respiratory disorders, pulmonary hypertension, neuromuscular, and chest wall disorders. Contraindications generally imply the patient's incapacity to complete the rehabilitation program for any reason.

Patients with angina pectoris, severe pulmonary hypertension, congestive heart failure, unstable diabetes, the inability to exercise for orthopedic or other reasons, etc., may be among those contraindications.[16]

The primary goals of pulmonary rehabilitation are to reduce symptoms, regain functionality, and improve overall quality of life. The results include an increase in peak oxygen consumption, 6MWT (six-minute walk test) distance, and SGRQ score. Therefore, the optimal pulmonary rehabilitation program should be designed to bring about precise changes in the underlying pathophysiology to improve functional skills. This will lead to symptomatic improvement and a reduction in handicap, thereby improving quality of life in a cost-effective and individualized manner.[16]

Pulmonary rehabilitation has an impact on aerobic capacity and health-related quality of life (QOL) in patients with tuberculosis sequelae. It utilizes an 8-week, 3-times-per-week program of aerobic training, therapeutic education, and activities of daily living. The aerobic exercise training starts at 60% of the maximum oxygen consumption and progresses up to 90%.[16]

Before prescribing pulmonary rehabilitation, simple symptom-limited exercise tests are administered to evaluate the patient's exercise capacity. The initial maximum exercise capacity can be assessed using dyspnea scores. Dyspnea scores can be evaluated using a variety of scales, such as the Borg 0-10 scale, which depicts the complete spectrum of dyspnea severity. A change of 1 unit on the Borg scale dyspnea measurement was considered clinically significant.[17]

Functional cardiorespiratory assessment can be done with the 6-MWT, shuttle walk test, or BODE (Body mass index, Obstruction, Dyspnea, Exercise capacity).[16] The 6-MWT is the most commonly used test. The reference value for the 6-MWT is 576 m for healthy male subjects and 494 m for healthy female subjects.

An increase in 6-MWT distance greater than 30.5 m can be regarded as clinically significant and serve as a reasonable benchmark for goal setting.[18] Δ 30-s STS of $\geq$ 2 repetitions represented the minimum clinically important difference, which may be predicted by the baseline ability in the 30-s STS test and lung function in terms of diffusing lung capacity.[19]

This patient presented with shortness of breath and a phlegmonous cough that was difficult to expel. These symptoms are the result of pleural effusion caused by chylothorax. During chylothorax, the accumulated pleural fluid restricts the diaphragm's expansion, leading to incomplete lung expansion. Consequently, the respiratory frequency increases to compensate for ventilation, resulting in dyspnea. In the sequelae phase with restrictive syndrome, other symptoms such as decreased exercise tolerance and chronic cough may occur.[4]

The patient receives a pulmonary rehabilitation program in an inpatient setting, which includes respiratory exercises and mobilization exercises. Regarding respiratory exercises, our focus is on increasing his chest expansion through chest therapy. Chest physical therapy is still used as a combination method in modern rehabilitation schedules. It involves breathing retraining (including purse-lip breathing), diaphragmatic breathing exercises, postural drainage, chest

percussion, chest vibration, and directed cough. The patient is provided with a set of exercises that include deep breathing exercises and chest expansion exercises. Additionally, he is given ACBT with huffing exercises and segmental breathing exercises three times a day to aid in airway clearance.[16]

Inspiratory muscle training can be considered as an adjunct to limb training for evaluating respiratory muscle training methods. A recent meta-analysis suggests that respiratory muscle strength training generally yields more benefits compared to inspiratory muscle endurance training. However, patients with weak inspiratory muscles have shown improvements in exercise performance through more inspiratory muscle training. In this case, the patient was prescribed Incentive spirometry exercises, to be performed five times a day, with 3 sets of 10 repetitions and 2-minute intervals.[16]

Exercise forms the core of the rehabilitation program. In this patient, the inability to exercise primarily stems from lower limb muscle problems. Exercise training has different effects on different muscle groups, and evidence-based guidelines say that training the lower extremities gives the best physiological gains. Lower extremity exercises are commonly performed on a treadmill or a cycle ergometer, although corridor walking can also be considered. Lower limb training has resulted in significant increases in exercise performance and health-related quality of life. The usual schedule involves at least three sessions per week for 4, 6, 8, or 12 weeks, with each exercise session lasting 30 minutes to 1 hour. The intensity and duration of exercise are typically limited by symptoms, and the type of exercise can be continuous or intermittent, focusing on endurance or strength training.[16]

During hospitalization, the patient experienced orthostatic hypotension due to prolonged bed rest. As a result, mobilization exercises were initiated, starting from sitting upright, to improve this condition. Once the orthostatic hypotension improved, a sit-to-stand test and a 6-minute walking test were performed to assess the patient's muscle and cardiopulmonary endurance. 6-minute walking test to assess the muscle and cardiopulmonary endurance of this patient. Due to space limitations in the hospital setting, a 15-meter track was used for the tests.[19]

Regarding muscle and endurance exercises, the patient received sit-to-stand exercises. Exercise training began at a comfortable level for the patient, ensuring no discomfort was experienced. The intensity of the exercises was gradually increased over time. The duration of the workouts was extended first, followed by an increase in intensity. High-intensity exercise, below 80% of maximum work capacity, was found to be more effective than low-intensity exercise, below 50% of maximum work capacity.

Strength training was also beneficial for improving muscle mass and strength.16 After nine days of treatment and pulmonary rehabilitation, improvements were observed in chest expansion, ranging from 2-3.5-4 cm to 3-4.5-5.5 cm.Inspiratory capacity, measured through incentive spirometry, increased from 1000 ml to 1500 ml. Muscle endurance, assessed by the sit-to-stand test, improved from 10 to 13 repetitions. Cardiorespiratory endurance, evaluated through the 6-minute walking test, increased from 262.5 meters (VO2max 9.66 and METS 2.76) to 280 meters (VO2max 10.59 and METS 3.02) With a cardiorespiratory endurance of METS 3.02, the patient was able to perform standing tasks with

light effort, but further endurance improvement to METS 4 was desired The rehabilitation goal for this patient is to improve their functional capacity to the point where they can stand and walk with moderate effort, taking into consideration their occupation as a security guard. Before discharge, the physiatrist has developed a home program for the patient, which includes moderate exercise. The program consists of aerobic exercises to be performed 3-5 times a week, with an intensity of 50-60%, a reserved HR of 121-130 beats per minute, and 30 minutes of walking.

One of the most crucial aspects of pulmonary rehabilitation is the assessment of the program's benefits. This assessment includes evaluating the quality of life, dyspnea levels, and functional parameters using various scales. Assessments can be conducted in real-time during the program or through recall assessments after the completion of the program.

CONCLUSION

Effective pulmonary rehabilitation involves a comprehensive approach that includes exercise schedules and patient education. This approach aims to support the gradual recovery and maintenance of a fully functional state for each individual patient. It is recommended to initiate pulmonary rehabilitation as early as possible for hospitalized patients with respiratory disorders to prevent further functional damage and enhance the improvement of their functional capacity.

REFERENCES

1. Kementerian Kesehatan Indonesia. Dashboard tuberkulosis Indonesia. https://tbindonesia.or.id/pustaka-tbc/dashboard-tb/ [cited 2022 Sep 15]
2. World Health Organization. Compendium of data and evidence-related tools for use in TB planning and programming [Internet]. Geneva: World Health Organization; 2021 [cited 2022 Apr 18]. Available from: https://apps.who.int/iris/handle/10665/3 44890
3. Ohene SA, Bakker MI, Ojo J, Toonstra A, Awudi D, Klatser P. Extra- pulmonary tuberculosis: A retrospective study of patients in Accra, Ghana. Cardona PJ, editor. PLOS ONE. 2019 Jan 9;14(1): e0209650.
4. Riley LE, Ataya A. Clinical approach and review of causes of a chylothorax. Respir Med. 2019 Oct; 157:7–13.
5. Croitoru A, Motoc N Ștefania, Ianosi ES, Todea D, Stanciu I, Alexescu TG, et al. Does respiratory rehabilitation improve the outcome of pleural effusion in pulmonology department? case report series and short literature review. Munteanu C, editor. Balneo Res J. 2019 Dec 10;10(Vol 10 No. 4):466–71.
6. Dourado VZ, Nishiaka RK, Simões MSMP, Lauria VT, Tanni SE, Godoy I, et al. Classification of cardiorespiratory fitness using the six-minute walk test in adults: Comparison with cardiopulmonary exercise testing. Pulmonology. 2021 Nov;27(6):500–8.
7. Febrianto D, Hadi U. Diagnostic and management problems of chylous effusion

in a patient with newly- diagnosed tuberculosis. Curr Intern Med Res Pract Surabaya J. 2021 Aug 12;2(2):35.

8. Rajagopala S, Kancherla R, Ramanathan RP. Tuberculosis-associated chylothorax: case report and systematic review of the literature. Respiration. 2018;95(4):260–8.
9. Gunjal SB, Shinde NK, Kazi AH, Mahajan AA. Effectiveness of deep breathing versus segmental breathing exercises on chest expansion in pleural effusion. Int J Health Sci. 2015;(7):7.
10. Canadian Lung Association, Canadian Thoracic Society, Public health agency of Canada, centre for communicable diseases and infection control (Canada). Canadian tuberculosis standards. 2014.
11. Lee CH, Lee MC, Lin HH, Shu CC, Wang JY, Lee LN, et al. Pulmonary tuberculosis and delay in anti- tuberculous treatment are important risk factors for chronic obstructive pulmonary disease. Pai M, editor. PLoS ONE. 2012 May 25;7(5):e37978.
12. Ravimohan S, Kornfeld H, Weissman D, Bisson GP. Tuberculosis and lung damage: from epidemiology to pathophysiology. Eur Respir Rev. 2018 Mar 31;27(147):170077.
13. Devi HJG. Complications of pulmonary tuberculosis. Dep Respir Med MS Ramaiah Med Coll Bangalore India. 2019 Apr;19.
14. Wirawan YR, Tansil CJ. Video- assisted thoracoscopic surgery in the treatment of empyema: a case series. Bali Med J. 2021 Apr 1;10(1):89.
15. Garvia V, Paul M. Empyema. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 [cited 2022 May 24]. Available from: http://www.ncbi.nlm.nih.gov/books/N BK459237/Rathod S, Samel DR, Kshirsagar P, Pokar M. Thrombocytosis: can it be used as a marker for tuberculosis? Int J Res Med Sci. 2017 Jun 24;5(7):30
16. Sharma BB, Singh V. Pulmonary rehabilitation: An overview. Lung India. 2011;28(4):276-284. doi:10.4103/0970-2113.85690
17. Bohannon RW, Crouch R. Minimal clinically important difference for change in 6-minute walk test distance of adults with pathology: a systematic review. J Eval Clin Pract. 2017;23(2):377-381. doi:10.1111/jep.12629
18. Zanini A, Crisafulli E, D'andria M, et al. Minimum clinically important difference in 30-s sit-to-stand test after pulmonary rehabilitation in subjects with copd. Respir Care. 2019;64(10):1261-1269. doi:10.4187/respcare.06694
19. Ries AL. Minimally clinically important difference for the UCSD shortness of breath questionnaire, borg scale, and visual analog scale. COPD J Chronic Obstr Pulm Dis.2005;2(1):105-110. doi:10.1081/COPD-200050655