MAGNA MEDIKA
Berkala Ilmiah Kedokteran dan Kesehatan
e-ISSN 2774-2318
p-ISSN 2407-0505

Case Report
MAGNA MEDIKA
Berkala Ilmiah Kedokteran dan Kesehatan
Journal Page: https://jurnal.unimus.ac.id/index.php/APKKM

Rehabilitation Management of a Patient with Bilateral Pulmonary Bullae after Multiple Surgeries and Post-Tuberculosis Lung Disease

Elisabeth Pauline Tifany[1], Tresia Fransiska Ulianna Tambunan[1]

[1,2)] Installation of Physical Medicine and Rehabilitation, PGI Cikini Hospital, Jakarta, Special Capital Region of Jakarta, Indonesia

Article Info

Article history:
Received 06 September 2023
Revised 27 November 2023
Accepted 29 November 2023
Available online 20 April 2025

Keywords:
post tuberculosis lung disease; pulmonary bullae; pulmonary rehabilitation

Correspondence:
elisabeth.tifany@gmail.com

How to cite this article:
Elisabeth Pauline Tifany, Tresia Fransiska Ulianna Tambunan. Rehabilitation Management of a Patient with Bilateral Pulmonary Bullae after Multiple Surgeries and Post-Tuberculosis Lung Disease. MAGNA MEDIKA Berk Ilm Kedokt dan Kesehat. 2025; 12(1):94-103

Abstract

Background: Post-tuberculosis lung disease (PTLD) is a prevalent finding in TB survivors. PTLD has many clinical presentations, including structural damage in the form of pulmonary bullae. Pulmonary bullae, along with PTLD, lead to significant impairment and morbidity in the patient. In some cases, a surgical approach is indicated for pulmonary bullae.

Objective: This case study aims to discuss the rehabilitation management in PTLD, including post-surgical cases.

Case Presentation: A 27-year-old male underwent lung volume reduction surgery (LVRS) by wedge resection of the right superior lobe. The patient had a history of tuberculosis infection and a history of bilateral pneumothorax. The patient underwent pulmonary rehabilitation in ICU care as early as medically possible, and continued until the patient was transferred to the general ward. The patient tolerates the pulmonary rehabilitation program, and no adverse effects occurred due to pulmonary rehabilitation.

Conclusion: Pulmonary rehabilitation is an essential part of cases involving PTLD, including post-surgical ones, and should be initiated as early as medically possible in inpatient and continued outpatient settings.

e-ISSN 2774-2318
p-ISSN 2407-0505

INTRODUCTION

Tuberculosis (TB) is one of the oldest infectious diseases known to man and is still a significant health problem throughout the world, especially in developing countries. A report by the World Health Organization (WHO) in 2020 estimated that 10 million people developed TB, with 1.2 million deaths worldwide. Indonesia is one such country in which TB is highly prevalent. Indonesian TB cases are estimated to account for 8.5% of all global TB cases, with the number of cases being the second highest in the world, just behind India.[1] One of the silver linings, despite the high number of TB cases, is the availability of chemotherapy for TB treatment. The global treatment success rates of TB average 85%, meaning that millions of people worldwide are cured of TB every year. Currently, it is estimated that there are 58 million TB survivors since 2000, with the total number of survivors alive in 2020 estimated to be over 155 million people.[2,3] Further studies have shown, however, that TB survivors often develop some degree of lung impairment after the TB infection is resolved. The current estimation states that half of all TB survivors have some form of pulmonary dysfunction despite a microbiologic cure.[4,5]

The presence of pulmonary dysfunction/ disease after TB infection is termed Post-Tuberculosis Lung Disease (PTLD)/ Pulmonary Impairment After Tuberculosis (PIAT).[2,5] PTLD presents with a diverse clinical spectrum, and no universal diagnostic criteria/ diagnostic tool exists today to define PTLD clearly.[2] PTLD can be grouped into several clinical presentation characteristics, including structural pathology and parenchymal damage in emphysema.[6] Emphysema, in turn, can further develop into pulmonary bullae. It is not uncommon to find TB patients/survivors who have developed pulmonary bullae.[7–9] People with pulmonary bullae usually present with various symptoms if the bullae are large enough, and they are at an increased risk of other complications, such as pneumothorax. The management includes multiple conservative treatments, although in some cases, surgery is warranted [8,10]

Pulmonary rehabilitation is integral to the medical management of patients with pulmonary bullae undergoing surgery.[11] Pulmonary rehabilitation could help optimize surgical and functional outcomes and minimize complications.[7,10] In this case report, a 27-year-old male with a history of pulmonary TB developed bilateral pulmonary bullae and underwent bullae removal surgery. This case report focuses on the role of a medical rehabilitation program in optimizing the patient's condition and helping with the patient's recovery.

CASE PRESENTATION

A 27-year-old male patient was referred to the Physical Medicine and Rehabilitation Department on May 18, 2022, in the ICU after undergoing decortication wedge resection thoracotomy due to the right superior pulmonary lobe, due to bilateral bullae secondary to pulmonary tuberculosis. The patient's dyspnoea had initially manifested a year prior, leading to hospitalization in Batam, where he was diagnosed with pneumothorax and underwent thoracocentesis on both hemithoraces. During this hospitalization, he was also re-diagnosed

e-ISSN 2774-2318
p-ISSN 2407-0505

with pulmonary tuberculosis, having previously suffered from the disease in 2020. Antituberculosis drug therapy was initiated, and despite completing a 12-month course of treatment, which ended in March 2022, the patient's dyspnoea persisted. A pulmonologist evaluated his antituberculosis therapy and ensured he followed the regimen correctly. The patient's social history included residing in a poorly ventilated household with limited sunlight exposure and frequent exposure to second-hand smoke from close friends who were active smokers.

Additionally, one of his close friends had a history of lung tuberculosis. He then underwent a thoracic CT scan, which showed that he had bilateral pulmonary bullae. Due to this finding, he was referred to the hospital. He was scheduled for thoracotomy surgery to remove part of his lungs that contained the bullae. He underwent the decortication wedge resection of the right superior lobe on May 17, 2022. After this surgery, he was admitted to the ICU for observation. He was successfully weaned from a ventilator and extubated less than 24 hours after surgery, but his hemodynamics were unstable with continuously reduced Hb level despite blood transfusion. A further examination from drain production, thorax x-ray, and hemodynamic status indicated ongoing bleeding of the right hemithorax, so he underwent a second thoracotomy surgery on May 21, 2022, for hematoma evacuation and bleeding control. After the second surgery, his condition was more stable. He was extubated 6 hours after surgery and had a stable Hb level. He still felt pain on the surgery site and a feeling of weakness, but he experienced no shortness of breath or dyspnoea. His prior illness history is not remarkable. There is no history of tuberculosis infection in his family. He did not smoke/consume alcohol. He was a student, and before his illness, he could do activities of daily living (ADL) and ambulate independently.

On physical examination post the second surgery, he was compos mentis, with stable blood pressure without any vasopressor, slight tachycardia, spontaneous breathing with 3 liters per minute oxygen supplementation through a nasal cannula. His saturation is stable at 99-100%. A general physical examination showed normal results. His weight is 55 kg, height is 169 cm, and his BMI is 19.3, indicating normal nutritional status. Respiromotor examination showed slight lung asymmetry, with the right side slightly delayed. There is no use of additional respiratory muscle, and no retraction is seen on inspection. No clubbing finger is present. A drain is still attached to the right hemithorax with serrohemorrhagic production of 130 cc/24 hours, with positive undulation but no air bubbles. On palpation, there is tenderness around the post-surgical area. Percussion showed dull results in the superior right hemithorax. Auscultation resulted in a weakened vesicular sound on the upper part of the right hemithorax, but there were no rhonchi or wheezing. Neuromuscular examination showed normal results. As for the mobilization status, he can tolerate sitting supported up to 90 degrees. However, he only tolerates sitting unsupported for 2 minutes due to feeling fatigued, but his vital signs are still within normal limits.

e-ISSN 2774-2318
p-ISSN 2407-0505

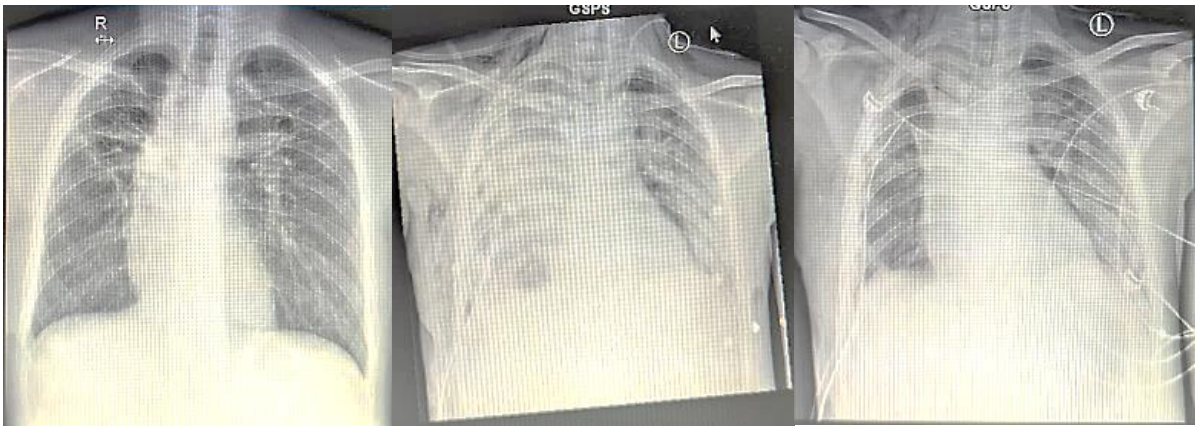

Figure 1. The patient's chest x-ray was on Apr 13 (leftmost), May 20 (center), and May 21 (rightmost).

His post-second surgery laboratory examination showed hemoglobin of 10.3, hematocrit of 30.3, leucocyte of 7740, and thrombocyte of 115000. His PT and aPTT were normal, and his Albumin was 3.5 with a normal electrolyte level. Both his kidney and liver function tests showed normal results. His latest chest x-ray on May 21, 2022, showed reduced consolidation and infiltration on both lungs, and no pneumothorax, pneumomediastinum, or subcutaneous emphysema was seen. Previous chest x-rays on May 19 and May 20, 2022, showed increasing pleural effusion and lung consolidation. Prior chest x-ray (Figure 1) result from pre-surgery on Apr 13, 2022, showed multiple bullae on both upper lobes of the lung. Similarly, the thoracal CT scan done on May 10, 2022, also showed multiple bullae on the superior lobe of the right lung and the 1st, second, and third segments of the left lung, as well as the presence of traction bronchiectasis.

After the second surgery and while still at the ICU, the patient was prescribed mobilization exercises sitting upright for two minutes three times daily, breathing exercises including pursed-lip breathing, deep diaphragmatic exercise, and segmental breathing using the lower right lobe every two hours, 3–5 repetitions as tolerated. He was also prescribed chest expansion exercises within pain tolerance three times a day, ankle pumping exercises three times, 15 repetitions, and an isometric lower extremity strengthening program three times, with ten repetitions with a six-second hold. The patient was also educated regarding airway clearance using an active cycle breathing technique and splinting each time he coughs. He was also encouraged to clear his sputum regularly.

On May 25, he was transferred to an inpatient ward. On follow-up, the patient felt the pain had decreased. He did not feel any shortness of breath, but he was still easily fatigued, although he tolerated it better than before. His drain also had been removed. His blood pressure is 107/70 mmHg, pulse is 90 times/minute, respiratory rate is 18 times/minute, and oxygen saturation is 99% in room air. A general physical examination showed normal results. Respiro-motor examination revealed a slight delay of the right hemithorax. No retraction/additional respiratory muscle used was examined. Chest expansion is 3-4-4 cm. Auscultation resulted in reduced vesicular sound on the

e-ISSN 2774-2318
p-ISSN 2407-0505

upper right lobe. The single breath count test result was 21. Mobilization examination showed that the patient could stand up and ambulate without complaint, and no changes were seen in the vital signs. His standing balance is adequate, and he can change position independently. The patient then underwent a six-minute walk test (6MWT). The initial Borg scale was 6-0-0. During testing, he stopped at the 3rd minute due to fatigue. His vital signs during this stoppage were: blood pressure 109/76, pulse 128 times/minute, respiratory rate 20 times/minute, saturation of 99% room air with a Borg scale of 13-2-2. He rested for 30 seconds and then continued the examination. He managed to achieve a distance of 165 meters. After the test, his blood pressure was 105/79, pulse was 125 times/minute, respiratory rate was 20 times/minute, saturation was 99%, and Borg scale was 11-2-2. His result is 28% of the predicted walking distance, with a predicted VO2 max of 10.62 and METs of 3.03.

The patient was planned to be discharged, so the patient was prescribed a home program of aerobic exercise in the form of walking starting from five minutes three times daily with a Borg scale target of 11-2-2, breathing exercise: purse-lipped breathing, deep diaphragmatic breathing, and segmental breathing five times a day each with 3-5 repetition, and chest expansion exercise. The patient was instructed to return to outpatient respiratory rehabilitation clinics for further rehabilitation programs.

DISCUSSION

Tuberculosis is an infectious disease caused by M. Tuberculosis. It primarily affects the lungs, although in some cases, it can also affect other organ systems, a condition called extra-pulmonary TB. While in the previous decade, focus and advances have been made on treating and curing TB with antituberculosis drug regimens with great success, in recent decades, it has become apparent that the problem of TB infection does not stop merely by curing the TB infection. Half of TB cases cured microbiologically have persistent pulmonary dysfunction, with studies showing that TB survivors have two to four-fold higher odds of persistently abnormal spirometry compared with those without previous TB disease.[2,4,12] PTLD/PIAT resulted in various respiratory symptoms, limitation in various physical abilities, and reduced quality of life.[3]

PTLD results from the interplay between direct damage caused by the tuberculosis organism in the lower respiratory tract and the host immune response. These processes, in turn, resulted in airway distortion, reduced elasticity, destruction of the muscular components of bronchial walls, or damage to the lung parenchyma and vasculature. All of these lead to structural pathology and anatomical distortion, as seen on imaging examination, abnormal respiratory physiology, as seen on spirometry examination, altered lung volumes, and impaired diffusing capacity. There is significant heterogeneity in the extent of lung impairment between persons. This condition is thought to result from host-pathogen interaction and, to some extent, the variability in gene coding for the complex array of host immune responses. The precise mechanism by which the host-pathogen interaction leads to various pathological changes in the lung is not fully understood. There are at least four primary components though to be involved: (1) the

e-ISSN 2774-2318
p-ISSN 2407-0505

process of granuloma formation and resolution, (2) cytokines production including tumor necrosis factor alpha and interleukins, (3) transcription factors including hypoxia-inducible factor, and (4) enzymes such as the matrix metalloproteinases/MMP (Figure 2).[2,4]

The clinical presentation of PTLD varies greatly from entirely asymptomatic to severe disability. PTLD encompasses heterogeneous and varied pathology, which can affect the airways, parenchyma, pleural, pulmonary vascular compartment, or a combination. The resulting respiratory symptoms end up as a combination of obstructive and restrictive disease. Structural damage can be seen, especially in imaging studies, and includes residual cavitation, bronchiectasis, fibrotic change, and parenchymal destruction (Figure 3). It is not uncommon to see anatomical distortion and destroyed lung tissue in patients with PTLD. If there is a loss of the distal lung architecture distal to the terminal bronchiole, it can lead to enlargement of the alveolar space, resulting in emphysema. Emphysema, on its own, can lead to limitation in airflow as well as the diffusion capacity of the lung. In some cases, this enlargement is large enough to be more than 1 cm in diameter and is called bullae/bullous emphysema. [2,4,8]

The presence of bullae resulted in further dysfunction of the pulmonary system in those with PTLD. There will be an increase in total lung capacity, but with a subsequent increase in residual volume and functional residual capacity, there will be a decrease in vital capacity. The destruction of the lung interstitium led to decreased lung diffusion capacity.[13] An air-filled cavity in the form of bullae could also lead to increased intraparenchymal pressure, increasing the likelihood of small airway obstruction leading to lung hyperinflation. These changes resulted in dyspnoea and poor activity tolerance in the patient. Other than this direct effect, pulmonary bullae could lead to other complications, including infection and pneumothorax.[8]

The patient in this case report has a history of tuberculosis infection. Still, despite finishing his antituberculosis drug treatment, his symptoms of dyspnoea did not resolve, indicating a possibility of PTLD. The patient, in his course of disease, then experienced sudden pneumothorax, which, after further evaluation, was caused by the presence of bullae. As the patient is not a smoker, and he had a history of TB infection, it can be concluded that he experienced pulmonary bullae in both lungs secondary to TB infection as part of PTLD. The presence of traction bronchiectasis and fibrosis on the thoracal CT scan further supports the possibility of PTLD in the patient. The combination of the presence of bilateral bullae and the presence of PTLD could be thought to be the main reason for his dyspnoea complaint.

In some cases, pulmonary bullae are indicated for surgery. One of the indications for choosing surgery as the treatment approach is the history of pneumothorax, such as this patient.[14] The surgery of choice is lung volume reduction surgery (LVRS) by wedge excision of the emphysematous tissue.[15] The surgery not only reduces the likelihood of complications from the bullae but also could improve lung function, as by removing the bullae, the size of the hyperinflated lung could be reduced, therefore improving the expiratory airflow of the remaining lung tissue.[8]

e-ISSN 2774-2318
p-ISSN 2407-0505

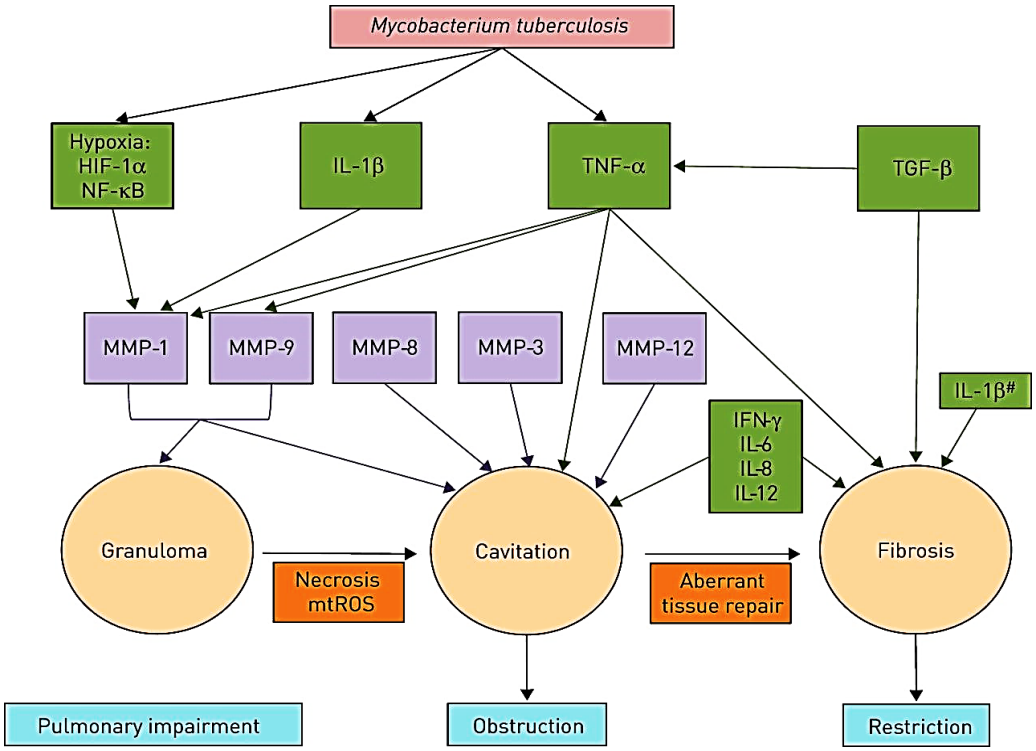

Figure 2. The pathophysiologic process involved in PTLD.[4]

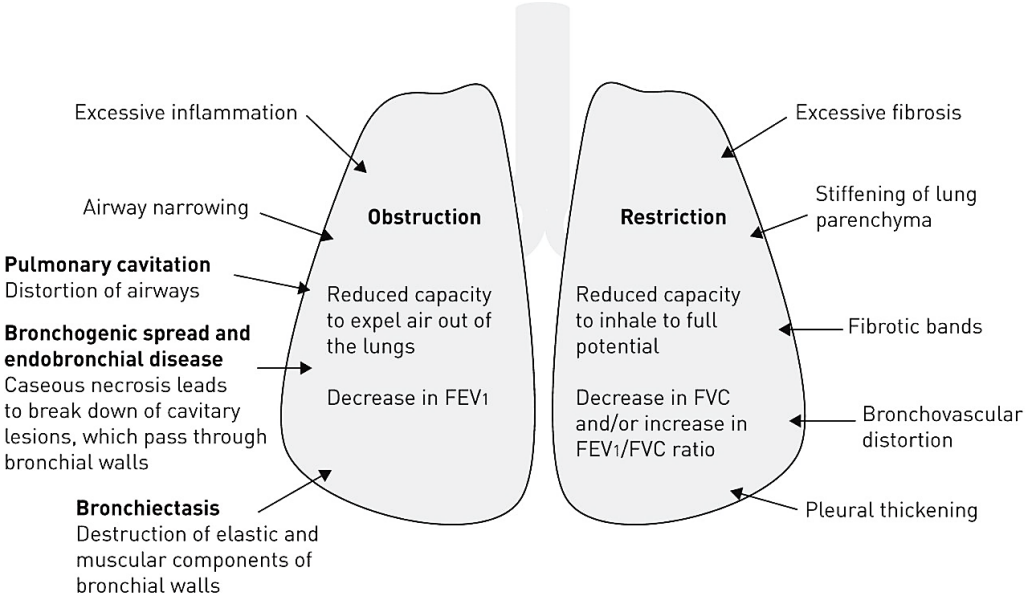

Figure 3. Pathological changes in the pulmonary system are associated with PTLD.[4]

Patients with PTLD, including those undergoing surgery like the patient in this case report, will benefit from pulmonary rehabilitation. For post-LVRS surgery, early rehabilitation and ambulation promote optimal lung recruitment and drive CO2 production, which drives the patient to ventilate and reduces the likelihood of immobility-related complications.[16] These will mitigate post-surgery complications such as postoperative atelectasis.[7] As for the PTLD, a pulmonary rehabilitation program involving aerobic

e-ISSN 2774-2318
p-ISSN 2407-0505

exercise, breathing exercise, strengthening exercise, and airway clearance technique is indicated in all cases.[17,18] The implementation must be tailored to the patient's condition and the feasibility in clinical settings.[19,20]

The patient in this case report was only able to do mobilization on the fourth day after the first surgery due to hemodynamic instability. Only after the second surgery to control the bleeding can the rehabilitation program be initiated safely. He was able to sit upright without support 24 hours after the second surgery, and he was able to ambulate around the bed three days after the second surgery. Based on his medical condition and functional evaluation, including 6MWT, he was prescribed simple aerobic exercise: walking for five minutes three times daily with a target Borg scale of 11-2-2. This program was chosen as opposed to the standard prescription of 30 minutes/day of aerobic exercise because the patient still has inadequate tolerance to physical activity, as shown by his need to rest while doing 6MWT due to fatigue. The patient was also prescribed breathing exercises to promote optimal chest expansion and lung recruitment and optimize the expiratory outflow.

Last, he was also educated about airway clearance techniques, as maintaining airway clearance is imperative to maximize lung expansion and prevent atelectasis. The presence of tractional bronchiectasis should also warn that the patient's sputum production could be higher than usual, despite him not complaining of such symptoms. The authors did not prescribe strengthening exercises to prevent excessive fatigue in the patient. The patient was instructed to return to the medical rehabilitation outpatient clinic so that further pulmonary rehabilitation programs could be done.

CONCLUSION

PTLD is a prevalent complication found in TB survivors, in which one of the presentations includes pulmonary bullae. Multimodal management of such patients is warranted, involving medical and surgical treatment and pulmonary rehabilitation. Pulmonary rehabilitation in post-surgery pulmonary bullae and PTLD aims to prevent post-surgery complications, optimize lung function, and aid the patient's recovery toward their functional status. Pulmonary rehabilitation should be initiated as early as medically possible and continued in outpatient settings.

REFERENCES

1. Chakaya J, Khan M, Ntoumi F, Aklillu E, Fatima R, Mwaba P, et al. Global tuberculosis report 2020 - reflections on the global tb burden, treatment and prevention efforts. Int J Infect Dis. 2021;113(1):7–12.
2. Allwood BW, Byrne A, Meghji J, Rachow A, Van Der Zalm MM, Schoch OD. Post-tuberculosis lung disease: clinical review of an under-recognised global challenge. Respiration. 2021;100(8):751–63.
3. Sotgiu G, Centis R, Migliori GB. Post-tuberculosis sequelae and their socioeconomic consequences: worth investigating. Lancet Glob Health. 2021;9(12):1628–9.
4. Ravimohan S, Kornfeld H, Weissman D, Bisson GP. Tuberculosis and lung damage:

e-ISSN 2774-2318
p-ISSN 2407-0505

from epidemiology to pathophysiology. Eur Respir Rev. 2018;27(147):170077.
5. Jones R, Kirenga BJ, Katagira W, Singh SJ, Pooler J, Okwera A, et al. A pre-post intervention study of pulmonary rehabilitation for adults with post-tuberculosis lung disease in Uganda. Int J Chron Obstruct Pulmon Dis. 2017;12;3533–39.
6. Kayongo A, Nyiro B, Siddharthan T, Kirenga B, Checkley W, Lutaakome Joloba M, et al. Mechanisms of lung damage in tuberculosis: implications for chronic obstructive pulmonary disease. Front Cell Infect Microbiol. 2023;13:1146571.
7. Kim SW, Kim D. Management of long-term persistent air leakage developed after bullectomy for giant bullous lung disease associated with neurofibromatosis type 1. J Thorac Dis. 2016;8(1):140.
8. Siddiqui NA, Mansour MK, Nookala V. Bullous Emphysema. StatPearls [Internet]. 2023 Jun 26 [cited 2023 Sep 5]; Available from: https://www.ncbi.nlm.nih.gov/books/NBK537243/
9. Jin J, Li S, Yu W, Liu X, Sun Y. Emphysema and bronchiectasis in COPD patients with previous pulmonary tuberculosis: computed tomography features and clinical implications. Int J Chron Obstruct Pulmon Dis. 2018;13:375–84.
10. Gatty A, Alaparthi GK, Kamath M M, Bairapareddy KC, Amaravadi SK. Early rehabilitation protocol for bullae repair and pleurectomy: a case report. Iran Rehabil J. 2021;19(2):207–13.
11. Visca D, Tiberi S, Centis R, D'Ambrosio L, Pontali E, Mariani AW, et al. Post-tuberculosis (TB) treatment: The role of surgery and rehabilitation. Vol. 10, Applied Sciences (Switzerland). MDPI AG; 2020.
12. Meghji J, Lesosky M, Joekes E, Banda P, Rylance J, Gordon S, et al. Patient outcomes associated with post-tuberculosis lung damage in Malawi: a prospective cohort study. Thorax. 2020;75(3):269–78.
13. Kiryukhina LD, Kokorina E V., Gavrilov P V., Denisova N V., Archakova LI, Yablonskiy PK. Gas exchange in patients with pulmonary tuberculosis: relationships with pulmonary poorly communicating fraction and alveolar volume. J Respir. 2023;3(2):107–17.
14. Asli RH, Aghajanzadeh M, Lahiji MR, Asli HH, Foumani AA, Pourahmadi Y. Results of the surgical treatment of pulmonary bleb and bullous disease: a retrospective study. Lung India. 2022;39(5):455.
15. Marchetti N, Criner GJ. Surgical approaches to treating emphysema: lung volume reduction surgery, bullectomy, and lung transplantation. Semin Respir Crit Care Med. 2015;36(4):592–608.
16. Rozenberg D. Rehabilitation pre- and post thoracic surgery: progress and future opportunities. Chron Respir Dis. 2023;20:14799731231165305.
17. Visca D, Zampogna E, Sotgiu G, Centis R, Saderi L, D'Ambrosio L, et al. Pulmonary rehabilitation is effective in patients with tuberculosis pulmonary sequelae. Eur Respir J. 2019;53(3):1802184.
18. Visca D, D'Ambrosio L, Centis R, Pontali E, Tiberi S, Migliori GB. Post-TB disease: a new topic for investigation-and why it matters. Int J Tuberc Lung Dis. 2021;25(4):258–61.

e-ISSN 2774-2318
p-ISSN 2407-0505

19. Migliori GB, Marx FM, Ambrosino N, Zampogna E, Schaaf HS, van der Zalm MM, et al. Clinical standards for the assessment, management and rehabilitation of post-TB lung disease. Int J Tuberc Lung Dis. 2021;25(10):797–813.
20. Katagira W, Orme MW, Jones A V., Kasiita R, Jones R, Barton A, et al. Study protocol for a randomised controlled trial assessing the impact of pulmonary rehabilitation on maximal exercise capacity for adults living with post-TB lung disease: Global RECHARGE Uganda. BMJ Open. 2021;11(8):047641.