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CASE REPORT

Bronchoscopy Balloon Dilatation and Pulmonary Rehabilitation To Prevent Recurrent Dyspnea In Post-Tuberculosis Lung Disease: A Case Report

"Synergistic Effects of Bronchoscopic Balloon Dilatation and Pulmonary Rehabilitation in Preventing Recurrent Dyspnea: A Post-Tuberculosis Case Report"

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ABSTRACT

Background: Post-tuberculosis lung disease (PTLD) frequently results in chronic airway complications, including cicatricial bronchial stenosis, which can cause recurrent dyspnea and impaired quality of life. Therapeutic bronchoscopy with balloon dilation and comprehensive pulmonary rehabilitation are emerging modalities for restoring airway patency and improving functional capacity.

Case Description: A 23-year-old female with treated pulmonary tuberculosis in 2020 presented with worsening dyspnea and productive cough. Bronchoscopy revealed near-total cicatricial stenosis of the right main bronchus. Sequential electrocautery via the Mercedes-Benz technique and balloon dilations with 8 mm and 9 mm balloons achieved airway patency, confirmed by passage of a 5.4 mm bronchoscope beyond the stenotic segment.

Discussion: Bronchoscopic balloon dilation has demonstrated safety and minimal invasiveness for tuberculosis-related bronchial stenosis, with low morbidity and manageable restenosis rates. Pulmonary rehabilitation, including Active Cycle Breathing Technique, diaphragmatic and deep-breathing exercises, mobilization, and energy conservation, aligns with WHO recommendations and significantly enhances lung function (FEV_1, FVC, DLCO), exercise capacity, and quality of life. The combination of interventional and rehabilitative strategies offers a comprehensive approach, optimizing functional recovery and reducing dyspnea.

Conclusions: Combining bronchoscopic balloon dilation with structured pulmonary rehabilitation effectively reduces airway obstruction and improves respiratory function in PTLD. Early intervention and ongoing rehabilitation are essential to sustain long-term benefits and prevent functional decline.

Keywords: Balloon-dilation, Bronchoscopy, Post-tuberculosis lung disease**,** Pulmonary rehabilitation

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INTRODUCTION

Post-tuberculosis lung disease (PTLD) is a significant and increasingly recognized chronic respiratory complication that occurs after successful treatment of pulmonary tuberculosis (TB). Following treatment, up to 50% of patients (and more) than 70% of those with multidrug-resistant TB develop PTLD, defined as "evidence of chronic respiratory abnormality, with or without symptoms, attributable at least in part to previous (pulmonary) TB[1]. PTLD encompasses a spectrum of lung function abnormalities and structural damage, including airway obstruction, fibrosis, bronchiectasis, and pulmonary hypertension, which contribute substantially to morbidity and mortality among TB survivors. Globally, an estimated 155 million people are living as TB survivors, with PTLD prevalence reported as high as 59.1% among them, underscoring the urgent need for awareness and management of this condition.[2,3]

Epidemiologically, Asia bears a significant burden of TB and subsequently PTLD, with Indonesia ranking second worldwide for TB incidence. Studies from Indonesia show a high prevalence of chronic respiratory symptoms and lung damage among post-TB patients, with persistent cough and radiological abnormalities like cavitation and fibrosis frequently documented.[4] In Indonesian cohorts, PTLD often coincides with chronic pulmonary aspergillosis, complicating disease outcomes.[5]

The mortality rate in PTLD can be up to three times higher than in the general population, with studies reporting postoperative mortality around 5.8% in patients undergoing surgery for tuberculosis-destroyed lung. TB survivors generally have a reduced life expectancy by about 5 years, even with timely treatment, and this risk increases with delayed or inadequate treatment.[6]

Regarding morbidity, 50% to 68% of TB survivors exhibit significant lung function impairment, such as obstructive or restrictive deficits, pulmonary fibrosis, or bronchiectasis. About 10-15% suffer severe lung function impairment, manifesting as chronic respiratory symptoms like cough, dyspnea, reduced exercise capacity, and lung function decline that occurs at a rate nearly 2.7 times faster than in healthy individuals.[7] The World Health Organization (WHO) recognizes rehabilitation as a fundamental health service that must be accessible to individuals with TB-related disabilities. Pulmonary rehabilitation (PR) has demonstrated benefits in various chronic respiratory conditions, notably COPD.[8] While some data support PR's effectiveness in PTLD patients, current recommendations rely on limited evidence from small, single-center studies—typically involving cohorts of 20–30 patients—and often lack comprehensive pre- and post-rehabilitation assessments, extrapolating findings from COPD populations.[1]

CASE DESCRIPTION

A 23-year-old female presented to the emergency department with worsening shortness of breath, particularly at night, starting one day before admission. A productive cough with whitish sputum accompanied the symptom. Due to these complaints, the patient reported being unable to sleep and was only able to remain in an upright sitting position. Loud and tight breath sounds were noted. Prior to admission to Persahabatan Hospital, the patient had been hospitalized for one week at Budi Asih Hospital with similar complaints. One day after being discharged, her shortness of breath recurred and worsened compared to the previous episode, prompting her visit to Persahabatan Hospital. The patient had a history of pulmonary tuberculosis diagnosed in 2020 and had completed a full course of anti-tuberculosis treatment. In 2022, she was hospitalized due to shortness of breath and was diagnosed with an asthma attack. At that time, the patient described severe symptoms with a feeling of being unable to breathe throughout the day. She reported that episodes of dyspnea have occurred repeatedly every year since then. On current physical examination, the patient was alert and compos mentis. Chest expansion was symmetrical. Auscultation revealed bilateral rhonchi and decreased vesicular breath sounds on the left lung.

Figure 1. Chest radiograph on admission (September 12th, 2025)

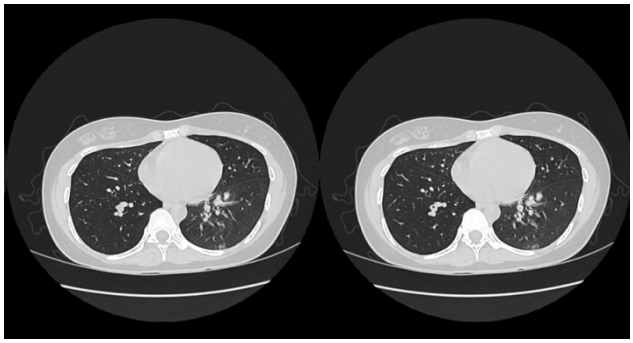

Figure 2. Thorax CT-Scan showed consolidation with fibrosis and tree in bud opacities

Chest X-ray (Figure 1) showed a thin infiltrate in the middle field of the right lung, superimposed on the posterior aspect of the 4th rib, suggestive of pneumonia, with mild dextroscoliosis of the thoracic vertebrae. A thoracic CT scan at Budi Asih Hospital (Figure 2) demonstrated consolidation with fibrosis and *'tree-in-bud*' opacities in segments 1 and 6 of the right and left lungs, respectively, as well as multiple calcifications in segment 4 of the right lung, supporting a differential diagnosis of pulmonary tuberculosis. No mediastinal lymphadenopathy was observed.

During hospitalization, the patient received medical management consisting of inhaled salbutamol and ipratropium bromide, intravenous levofloxacin 750 mg, intravenous methylprednisolone 40 mg, intravenous ranitidine 50 mg, and oral N-acetylcysteine 200 mg. On the third day of hospitalization, the patient was referred to the Physical Medicine and Rehabilitation Department. She was enrolled in a pulmonary rehabilitation program that included Active Cycle Breathing Technique (ACBT), diaphragmatic breathing exercises, deep breathing exercises, out-of-bed mobilization, and energy conservation techniques. On September 15th, the patient underwent bronchoscopy with balloon dilatation. Bronchoscopy findings revealed cicatricial mucosa at the proximal trachea and a cicatricial stenosis nearly completely occluding the right main bronchus orifice. Electrocautery (*Mercedes-Benz* technique) was followed by two balloon dilatations (8 mm and 9 mm). After dilatation, a 5.4 mm bronchoscope was able to pass through the stenotic area and visualize the right main bronchus branches clearly without distal lesions. Following the procedure, the patient reported a significant improvement in dyspnea, was able to ambulate to the bathroom without shortness of breath and experienced much less respiratory distress. She occasionally still reported a productive cough with whitish sputum, sometimes streaked with small amounts of blood, but not frequently.

DISCUSSION

This case clearly illustrates the critical role of bronchoscopy and balloon dilation as therapeutic modalities in patients with post-tuberculosis lung disease (PTLD) who develop cicatricial bronchial stenosis. In this 23-year-old female with a history of pulmonary tuberculosis treated in 2020, bronchoscopy revealed cicatricial stenosis that nearly resulted in complete occlusion of the right main bronchus, reflecting a long-term complication of endobronchial tuberculosis.

Role of Bronchoscopy Balloon Dilation

The bronchoscopy finding of cicatricial stenosis in the right main bronchus aligns with the literature, which reports that healing of tracheobronchial tuberculosis may cause tracheobronchial fibrosis, leading to airway stenosis in 11–42% of patients. Management with electrocautery using the Mercedes-Benz technique followed by sequential balloon dilations with 8 mm and 9 mm balloons represents an appropriate, guideline-based approach. Procedural success was demonstrated by passage of a 5.4 mm bronchoscope through the stenotic segment and visualization of the right bronchial tree without distal lesions, indicating adequate airway patency. These findings align with studies demonstrating that balloon dilation is a safe, effective, and minimally invasive procedure for treating tuberculosis-related bronchial stenosis. Recent research further demonstrates that balloon dilation can be repeated with a high safety profile with manageable rates of restenosis.[9,10]

Role of Pulmonary Rehabilitation

The pulmonary rehabilitation program for this patient included the Active Cycle of Breathing Technique (ACBT), diaphragmatic breathing exercises, deep breathing exercises, out-of-bed mobilization, and energy conservation techniques. This comprehensive approach aligns with WHO recommendations that rehabilitation is an essential health service for individuals with tuberculosis-related disability. Recent multicenter studies have demonstrated that a 5-week pulmonary rehabilitation program yields significant benefits in patients with PTLD, including improvements in FEV_1, FVC, DLCO, six-minute walk distance, and oxygen saturation.[1] In Tanzania, a 24-week community-based

rehabilitation program led by TB survivors demonstrated significant gains in respiratory quality of life and walking distance. Home-based pulmonary rehabilitation programs have also proven effective in enhancing exercise tolerance, quality of life, and small airway function in patients with PTLD, underscoring the flexibility of rehabilitation implementation according to local healthcare contexts.[11]

Prognosis and Follow-Up

Short-term success achieved in this case warrants long-term monitoring due to the potential for restenosis. Studies report restenosis occurring 3–21 months after balloon dilation, but the procedure can be safely repeated. Ongoing pulmonary rehabilitation is key to maintaining optimal respiratory function and preventing further deterioration.[12]

CONCLUSION

This case highlights the synergistic benefits of bronchoscopy balloon dilation and pulmonary rehabilitation in managing cicatricial bronchial stenosis resulting from post-tuberculosis lung disease. Balloon dilation restored airway patency with a minimally invasive technique, while a tailored rehabilitation program significantly improved pulmonary function and exercise capacity. Early bronchoscopy intervention, even immediately post-tuberculosis therapy for life-threatening stenosis, combined with sustained pulmonary rehabilitation, constitutes an optimal multidisciplinary strategy to address both structural and functional sequelae of PTLD. Continuous follow-up is necessary to monitor for restenosis and maintain long-term respiratory health.

DISCLOSURE

The authors have nothing to disclose.

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DECLARATION OF PATIENT CONSENT

We confirm that the patient's consent has been obtained. The patient has agreed to have their clinical information published in the journal. The patient understands that their name and initials will remain confidential and will not be disclosed.

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AUTHOR'S CONTRIBUTION

All authors participated fully in this research process, including study design, data collection and analysis, manuscript drafting, and approval for publication.

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