

## Massive Pleural Effusion as the Initial Manifestation of Pulmonary Tuberculosis in an Adolescent: A Case Report

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### Abstract

**Introduction:** Tuberculosis remains a major global health problem and may present with nonspecific manifestations in adolescents, including pleural effusion, which can complicate diagnosis. Massive pleural effusion as an initial manifestation of pulmonary tuberculosis is uncommon and requires prompt diagnostic evaluation. **Case Report:** A 15-year-old male adolescent presented with progressive dyspnea, cough, intermittent fever for more than two weeks, decreased appetite, and weight loss. Physical examination revealed decreased breath sounds and stony dullness over the right hemithorax. Chest radiography showed massive right pleural effusion with mediastinal shift. Initial thoracentesis produced approximately 1,600 mL of seroanchochromic fluid, with a total drainage volume of 2,850 mL following repeated aspiration. Pleural fluid analysis confirmed an exudative effusion with protein 5.1 g/dL and lactate dehydrogenase 1,100 U/L. Molecular testing of pleural fluid detected *Mycobacterium tuberculosis* at a trace level without rifampicin resistance. The patient received first-line anti-tuberculosis therapy and supportive treatment, resulting in gradual clinical improvement during an 8-day hospitalization. **Discussion:** This case shows the importance of combining clinical, radiological, pleural fluid, and molecular findings to diagnose pleural tuberculosis. Early molecular testing supported prompt treatment initiation and favorable clinical recovery. **Conclusion:** Massive pleural effusion in adolescents should raise suspicion for tuberculosis, particularly in endemic areas. Early diagnosis and timely anti-tuberculosis therapy are essential to improve outcomes and prevent complications.

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### Introduction

Tuberculosis (TB) remains one of the most important global public health problems and continues to be among the leading causes of death from a single infectious agent worldwide (Zumla *et al.*, 2025). According to the World Health Organization, TB maintained a substantial global burden through 2025, with millions of new cases reported annually and developing countries contributing a significant proportion of these cases (World Health Organization, 2025). Indonesia is among the countries with the highest TB burden, where childhood and adolescent TB remains a major challenge for clinicians and public health systems. In pediatric populations, the diagnosis of TB is often complicated by nonspecific clinical manifestations and the difficulty of obtaining microbiological confirmation. These challenges are even greater in cases of extrapulmonary TB, which may present with atypical features and delayed recognition (Ministry of Health Republic of Indonesia, 2023; Ikatan Dokter Anak Indonesia, 2023). Early diagnosis and timely treatment are essential to reduce morbidity and prevent long-term complications.

Extrapulmonary TB accounts for a meaningful proportion of all TB cases, with pleural involvement representing one of the most common forms (Jones *et al.*, 2025; Inchingolo *et al.*, 2025). Tuberculous pleural effusion (TPE) develops as a delayed hypersensitivity reaction to Mycobacterium tuberculosis antigens that enter the pleural space. This immunologic response leads to increased capillary permeability and accumulation of protein-rich pleural fluid. TPE is frequently observed in adolescents and young adults and may represent the first manifestation of either primary infection or reactivation of latent disease. In immunocompetent individuals, pleural TB can occur even in the absence of extensive pulmonary parenchymal lesions. Consequently, pleural effusion should be considered an important presentation of TB in endemic areas (Ministry of Health Republic of Indonesia, 2023; Ikatan Dokter Anak Indonesia, 2023; World Health Organization, 2022; Pygott *et al.*, 2026).

The clinical presentation of TPE in adolescents is often nonspecific and may include fever, cough, pleuritic chest pain, dyspnea, anorexia, and weight loss. Because these symptoms overlap with those of bacterial pneumonia, malignancy, and other inflammatory disorders, establishing the diagnosis can be challenging. In some patients, pleural fluid accumulates progressively and may become moderate to massive in volume (Ferreiro *et al.*, 2025). Massive pleural effusion can result in significant compression of the ipsilateral lung, impaired ventilation, and mediastinal shift. This condition may cause acute respiratory distress and requires prompt recognition and intervention. Although massive tuberculous pleural effusion is relatively uncommon in adolescents, it has important clinical implications and should not be overlooked (World Health Organization, 2022; Porcel, 2022).

The diagnosis of TPE remains difficult because conventional microbiological tests, such as acid-fast bacilli smear of pleural fluid, have low sensitivity. Therefore, a comprehensive diagnostic approach is required, integrating clinical findings, epidemiological history, imaging studies, and pleural fluid analysis. Typical pleural fluid findings include an exudative effusion with high protein concentration, elevated lactate dehydrogenase, lymphocyte predominance, and increased adenosine deaminase (ADA) levels. Molecular assays such as Xpert MTB/RIF Ultra have further improved the diagnostic yield by enabling rapid detection of Mycobacterium tuberculosis and rifampicin resistance. National guidelines in Indonesia and recommendations from the Ikatan Dokter Anak Indonesia emphasize the importance of an integrated clinical and

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laboratory approach for diagnosing pediatric and adolescent TB, particularly in extrapulmonary disease (Ministry of Health Republic of Indonesia, 2023; Ikatan Dokter Anak Indonesia, 2023).

The mainstay of treatment for tuberculous pleural effusion is standard first-line anti-tuberculosis therapy administered for at least six months (Jones *et al.*, 2025). In patients with moderate to massive effusions associated with respiratory compromise, therapeutic thoracentesis or pleural drainage may be necessary to relieve symptoms and improve lung expansion. Delayed diagnosis and treatment may result in residual pleural thickening, fibrosis, and long-term restrictive pulmonary dysfunction (Ministry of Health Republic of Indonesia, 2023; Ikatan Dokter Anak Indonesia, 2023; Shaw *et al.*, 2023). Therefore, clinicians practicing in TB-endemic regions should maintain a high index of suspicion for tuberculosis in adolescents presenting with unilateral pleural effusion. This case report describes a massive pleural effusion as the initial manifestation of pulmonary tuberculosis in an adolescent and highlights the importance of a rapid, systematic, and multimodal diagnostic approach to achieve optimal clinical outcomes.

### **Case Report**

A 15-year and 1-month-old male adolescent presented to the Emergency Department on April 2, 2026, with a chief complaint of progressively worsening shortness of breath. The dyspnea had been present for approximately two weeks prior to admission and had become significantly worse during the last two days before hospitalization. The shortness of breath was more pronounced during physical activity and improved slightly with rest.

The patient also reported a cough that had started two weeks before admission. Initially mild, the cough gradually became more severe over time. It was productive of clear sputum without hemoptysis. The patient also experienced intermittent fever for approximately two weeks before admission. The fever was low-grade and improved with antipyretic medication. There was an unintentional weight loss of approximately 2 kg over one month, from 80 kg to 78 kg. Night sweats were denied. Appetite and oral fluid intake remained relatively good. Bowel and urinary habits were within normal limits.

Two weeks before admission, the patient sought treatment from a general practitioner and received unspecified oral medications, which resulted in temporary improvement. Two days before admission, the dyspnea and cough worsened again, prompting a visit to a local clinic where he received nebulized salbutamol with transient improvement. He was discharged with cough medication and salbutamol. However, because the shortness of breath progressively worsened again, he was subsequently brought to the Emergency Department of Wangaya General Hospital.

The patient denied any known direct contact with individuals diagnosed with tuberculosis. However, his father had died two months earlier with a final diagnosis of B24 (suspected HIV/AIDS) and a history of chronic cough for approximately one month that had never been further evaluated. The patient was born spontaneously at home, and his birth weight and birth length were unknown. His immunization history was incompletely documented, but there was no history of developmental delay. He was a student and had no history of active or passive smoking, and there was no significant exposure to cigarette smoke.

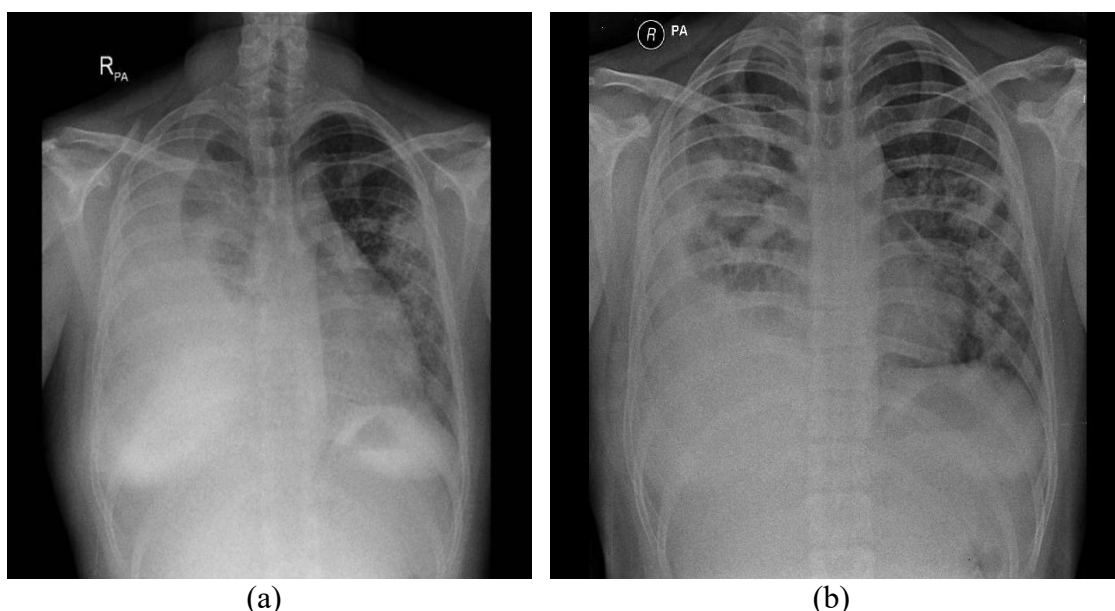
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On physical examination, the patient appeared in good general condition and was fully conscious (*compos mentis*). Nutritional assessment showed overweight status, with a body mass index (BMI) of 26.97 kg/m<sup>2</sup>, body weight of 78 kg, height of 170 cm, and mid-upper arm circumference of 30 cm. Anthropometric evaluation demonstrated a BMI-for-age above the 95th percentile.

Thoracic examination revealed asymmetry of the chest wall, with decreased expansion of the right hemithorax compared with the left side, and lagging respiratory movement on the right side. Palpation demonstrated decreased right-sided thoracic expansion and markedly reduced tactile vocal fremitus over the right hemithorax. Percussion of the right hemithorax revealed dullness to stony dullness over a wide area, suggesting pleural fluid accumulation, whereas the left hemithorax was resonant. Auscultation revealed decreased vesicular breath sounds over the right hemithorax, particularly in the second to sixth intercostal spaces, with minimal non-dominant crackles (+/-).

### Supporting Examinations

Supporting investigations included complete blood count, serum electrolytes, and blood chemistry analysis to evaluate the patient's overall clinical condition. Radiological examinations consisted of chest radiography and thoracic ultrasonography to assess the presence and extent of pleural effusion. To determine the underlying etiology, pleural fluid analysis was performed through thoracentesis, including physical examination, biochemical analysis, and the Rivalta test. Molecular testing using the rapid molecular assay (TCM/Xpert MTB/RIF) on pleural fluid was also performed to detect the presence of *Mycobacterium tuberculosis*.



**Figure 1.** Chest Radiographs Before and After Therapy

Figure 1, shows (a) Chest radiograph obtained before therapy (April 2, 2026) massive right pleural effusion with near-complete opacification of the right lung field, with a possible underlying lung mass that could not be excluded, as well as pneumonia,

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(b) Chest radiograph obtained after therapy (April 25, 2026) right pleural effusion with a reduced fluid volume compared with the previous examination, with findings suggestive of active pulmonary tuberculosis.

**Table 1**

**Pleural Fluid Analysis and Serum Chemistry Results According to Light's Criteria**

Examination	Result
Macroscopic Findings	
Color	Yellow
Appearance	Cloudy
Clot Formation	Positive
pH	7.0
Biochemical Analysis	
Rivalta Test	Positive
Glucose	92 mg/dL
Protein	5.1 g/dL
Albumin	3.88 g/dL
LDH	1100 U/L
Serum Chemistry	
Pleural Protein	5.1 g/dL
Pleural LDH	1100 U/L
Serum LDH	430 U/L
Conclusion	Exudative Pleural Effusion

Complete blood count showed leukocytosis of  $13.08 \times 10^3/\mu\text{L}$ , hemoglobin of 17.4 g/dL, hematocrit of 51.4%, and platelet count of  $404 \times 10^3/\mu\text{L}$ . Blood chemistry results were within normal limits. The relatively elevated hemoglobin and hematocrit values were considered consistent with relative hemoconcentration associated with mild chronic inflammation or hypoxia. Molecular testing of the pleural fluid using the rapid molecular assay (TCM/Xpert MTB/RIF) detected *Mycobacterium tuberculosis* at a trace level, with no rifampicin resistance detected. On April 6, 2026, bedside thoracic ultrasonography was performed and demonstrated fluid accumulation within the pleural cavity, consistent with right pleural effusion.

### Diagnosis

The patient was diagnosed with massive right pleural effusion secondary to pleural tuberculosis (tuberculous pleuritis) based on the clinical presentation, radiological findings, exudative pleural fluid analysis, and rapid molecular assay results showing *Mycobacterium tuberculosis* detection.

### Management

During hospitalization, the patient underwent pleural aspiration twice for both therapeutic and diagnostic purposes. The first thoracentesis was performed at the sixth intercostal space along the right posterior axillary line, yielding 1,600 mL of sero-xanthochromic fluid. The procedure was discontinued because the patient developed coughing during the aspiration.

A second thoracentesis was subsequently performed at the same site, yielding an additional 1,250 mL of sero-xanthochromic fluid. This procedure was also terminated because the patient again developed coughing during the intervention. In total, 2,850 mL of pleural fluid was successfully evacuated.

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The patient received oxygen therapy at 2 L/min via nasal cannula, intravenous D5 ½ normal saline at a rate of 30 drops per minute, intravenous ceftriaxone 1 g twice daily for five days, intravenous ranitidine, intravenous diphenhydramine, oral ambroxol, and methylprednisolone 8 mg twice daily.

In addition, the patient was started on first-line anti-tuberculosis treatment in the intensive phase (RHZE, 4 tablets daily) on April 6, 2026, with a planned duration of 56 days. During the 8-day hospitalization, the patient demonstrated gradual clinical improvement.

### **1. Discussion**

Tuberculous pleural effusion (TPE) is one of the most common manifestations of extrapulmonary tuberculosis, particularly in countries with a high TB burden such as Indonesia. According to the World Health Organization, tuberculosis remains a major global health problem through 2025, with extrapulmonary forms contributing substantially to the overall disease burden and often experiencing delayed diagnosis (World Health Organization, 2025). In Indonesia, the diagnosis of TB in children and adolescents continues to be challenging, especially in extrapulmonary cases where clinical manifestations are frequently nonspecific (Ministry of Health Republic of Indonesia, 2023; Ikatan Dokter Anak Indonesia, 2023). Pleural involvement may occur as an isolated manifestation or in association with pulmonary disease. Because microbiological confirmation is often difficult to obtain, clinicians must rely on a combination of epidemiological, clinical, radiological, and laboratory findings. This makes tuberculous pleural effusion a particularly important diagnostic consideration in endemic settings.

In the present case, the adolescent presented with a subacute course characterized by progressive dyspnea, cough, intermittent fever, and weight loss over a two-week period. This clinical pattern is consistent with the typical presentation of TPE, which generally develops gradually and is accompanied by mild to moderate constitutional symptoms. In adolescents, the presenting symptoms may overlap with those of bacterial pneumonia, malignancy, or other inflammatory conditions, making the initial diagnosis difficult. The absence of a confirmed history of direct tuberculosis contact does not exclude the diagnosis, particularly in endemic areas. In this case, the father's recent death with suspected HIV/AIDS and chronic cough raised the possibility of unrecognized household exposure to *Mycobacterium tuberculosis*. This epidemiological background further strengthened the suspicion of tuberculosis as the underlying etiology (World Health Organization, 2022; Porcel, 2022).

Radiological examination in this patient demonstrated massive right-sided pleural effusion with near-complete opacification of the right hemithorax. Tuberculous pleural effusions can vary considerably in volume, ranging from small unilateral effusions to massive collections associated with mediastinal shift. Although unilateral pleural effusion is common in TPE, massive effusions are relatively uncommon in adolescents. Large pleural collections can significantly impair lung expansion, reduce ventilation, and increase the work of breathing, as observed in this patient. These physiological effects may lead to acute respiratory distress and necessitate urgent intervention. Therefore, recognition of the radiographic pattern is crucial for timely diagnosis and management (Porcel, 2022; Koegelenberg *et al.*, 2024).

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Pleural fluid analysis in this case revealed an exudative effusion according to Light's criteria, with elevated protein concentration and markedly increased lactate dehydrogenase (LDH). These findings are characteristic of TPE and reflect the underlying immunopathological process, in which delayed hypersensitivity to *Mycobacterium tuberculosis* antigens causes increased pleural capillary permeability and accumulation of protein-rich inflammatory fluid. In most cases, tuberculous pleural fluid is lymphocyte-predominant and may also demonstrate elevated adenosine deaminase (ADA) levels. However, no single laboratory parameter is entirely diagnostic. The rapid molecular assay Xpert MTB/RIF detected *Mycobacterium tuberculosis* at a trace level, with no rifampicin resistance detected, providing strong microbiological support for the diagnosis. The integration of pleural fluid characteristics and molecular testing significantly improved diagnostic confidence in this case (World Health Organization, 2022; Porcel, 2022).

Recent studies have shown that pleural biomarkers such as adenosine deaminase (ADA) and lactate dehydrogenase (LDH) may support the diagnosis of tuberculous pleural effusion, particularly when combined with molecular testing (Liu *et al.*, 2022; Zhao *et al.*, 2024). These biomarkers are considered useful adjunctive tools for differentiating tuberculous from non-tuberculous pleural effusions. Elevated ADA and LDH levels are commonly associated with inflammatory and immunological responses in pleural tuberculosis. However, these biomarker examinations were not comprehensively performed in the present case. Despite this limitation, pleural fluid analysis showed an exudative effusion according to Light's criteria. In addition, the positive Xpert MTB/RIF result provided strong microbiological evidence supporting the diagnosis of pleural tuberculosis.

Systemic inflammatory status may also influence the interpretation of pleural biomarkers. Jeon *et al.* reported that elevated inflammatory markers, including leukocyte count and C-reactive protein, can affect the diagnostic performance of pleural fluid parameters (Jeon *et al.*, 2023). In the present case, mild leukocytosis was observed, reflecting an active inflammatory response. This finding supports the presence of ongoing infection and is consistent with the pathophysiological mechanism of tuberculous pleuritis. Nevertheless, leukocytosis alone is nonspecific and should be interpreted in the broader clinical context. Comprehensive assessment remains essential to avoid diagnostic errors. Combining systemic and pleural findings provides a more reliable approach to clinical decision-making.

Therapeutic thoracentesis was performed twice in this patient, resulting in a total drainage volume of 2,850 mL and significant symptomatic improvement. In cases of large or massive pleural effusions, pleural drainage plays a crucial role in reducing dyspnea and facilitating lung re-expansion. The procedures were appropriately terminated when the patient developed coughing, a common event during large-volume drainage. Clinicians must remain vigilant for complications such as pneumothorax and re-expansion pulmonary edema, although these events are relatively uncommon when thoracentesis is performed carefully. The marked improvement in respiratory symptoms after fluid evacuation underscores the importance of therapeutic drainage in selected patients with TPE (Porcel, 2022; Koegelenberg *et al.*, 2024).

The cornerstone of treatment for tuberculous pleural effusion remains standard first-line anti-tuberculosis therapy, typically administered for a minimum of six months. Most patients respond favorably to treatment when therapy is initiated promptly after diagnosis. In this case, the patient received first-line therapy in the intensive phase

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(RHZE), with progressive clinical improvement during hospitalization. Delayed diagnosis and treatment may result in residual pleural thickening, fibrosis, and long-term restrictive pulmonary impairment (World Health Organization, 2022; Shaw *et al.*, 2023). Adjunctive corticosteroid therapy remains controversial, although it may be considered selectively in patients with severe inflammation or massive pleural effusion. The decision to use corticosteroids should be individualized based on clinical judgment and patient response (Koegelenberg *et al.*, 2024; Shaw *et al.*, 2023).

This case highlights the importance of maintaining a high index of suspicion for tuberculosis as a major cause of pleural effusion in adolescents living in TB-endemic regions. The combination of subacute constitutional symptoms, unilateral massive pleural effusion, exudative pleural fluid characteristics, and molecular detection of *Mycobacterium tuberculosis* established a strong diagnostic foundation. Early therapeutic thoracentesis and prompt initiation of anti-tuberculosis treatment resulted in favorable short-term outcomes. This report shows the value of a multidisciplinary approach involving clinical evaluation, radiology, laboratory analysis, and molecular diagnostics. Such a comprehensive strategy is essential to accelerate diagnosis, guide appropriate therapy, and improve patient outcomes.

### **Conclusion**

Massive tuberculous pleural effusion in adolescents is a relatively uncommon manifestation of extrapulmonary tuberculosis, but it has significant clinical implications because it may lead to acute ventilatory impairment and respiratory distress. This case demonstrates that the diagnosis of tuberculous pleural effusion cannot be established solely on the basis of nonspecific clinical symptoms, but requires a comprehensive approach that includes clinical evaluation, radiological assessment, pleural fluid analysis, and molecular testing. The identification of exudative pleural fluid according to Light's criteria, together with detection of *Mycobacterium tuberculosis* by rapid molecular testing (TCM/Xpert MTB/RIF), strongly supported the diagnosis of pleural tuberculosis in this patient. Repeated therapeutic thoracentesis resulted in significant clinical improvement, particularly in reducing dyspnea associated with the massive pleural effusion. This case shows the importance of maintaining a high index of suspicion for tuberculosis as a major cause of pleural effusion in adolescents living in endemic areas. Early diagnosis and prompt initiation of anti-tuberculosis therapy are essential to prevent long-term complications, including pleural fibrosis and restrictive pulmonary dysfunction.

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