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Case Report

Bullous Lung Disease due to Pulmonary Tuberculosis: A Rare Case Complicated With Tension Pneumothorax and Bronchopleural Fistula

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Abstract

Bullous lung disease caused by tuberculosis is rare, and complications have a poor prognosis with uncertain pathophysiologic mechanisms. We describe a 29-year-old male patient who was admitted to the emergency department due to bilateral tension pneumothorax, which was complicated by bronchopleural fistula. This was managed with the placement of chest tubes, continuity of anti-TB drug treatment, and Heimlich valve placement.

Keywords: Tuberculosis, pneumothorax, bullae, bronchial fistula

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Introduction

Tuberculosis (TB) occurs annually with more than 10.6 million new cases worldwide and is the cause of multiple complications in the lung and pleura.[1] However, they rarely produce pulmonary bullae, which are defined as an airspace with a diameter greater than 1 cm in diameter with a wall less than or equal to 1 mm, and may occupy more than 30% of the lung (giant bullae).[2]

Bullous lung disease (BLD) is caused by an integral alteration of the epithelial cell structure, resulting in loss of elasticity of the alveolar sacs, leading to enlargement of the air spaces. This has been mainly associated with tobacco use, marijuana use, alpha-1 antitrypsin deficiency, and secondary to infections such as HIV or COVID-19.[3] While its association with TB is rare and often unknown.

In BLD, due to the presence of multiple bullae with different diameters, their rupture can trigger secondary spontaneous pneumothorax. For this reason, we describe the rare association between BLD and TB with different complications.

The reporting of this study conforms to the CARE checklist.[4]

Case Report

We present a 29-year-old male patient who was diagnosed with pulmonary TB by microscopy with sputum smear and positive culture. For the past 2 months, he has been consistently receiving sensitive treatment with isoniazid (INH), rifampicin (RIF), ethambutol (EMB), and pyrazinamide (PZA). In addition, he has only experienced occasional symptoms of a dry cough. The patient did not report any other significant medical history.

He was admitted to the emergency room with an illness time of 18 h characterized by sudden dyspnea (mMRC 4 scale), pain in both hemithorax in the scapular and external infrascapular region associated with diaphoresis, and a demanding cough. Blood pressure: 140/91 mm Hg, tachycardia (132 beats/min) and tachypnea (32 beats/min), Sato2: 85% (Fio2: 21%) were recorded. On preferential physical examination, chest and lungs: signs of poor chest expansion with intercostal indrawing's were noted. Tympany noted on chest percussion

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with decreased vocal vibrations. On auscultation, vesicular sounds were abolished in both lung bases. Cardiovascular: very low intensity rhythmic heart sounds, mild jugular vein engorgement, adequate peripheral pulse. In complementary tests: hemoglobin: 13.1 mm^3; leukocytes: 12 115 mm^3; platelets: 630,600 mm^3. Arterial blood gas analysis: pH: 7.38, Pco2: 29.7 mm Hg, PO2: 49 mm Hg, PO2/Fio2: 233 mm Hg. Negative serology and autoimmune profile. In imaging, chest x-ray shows bilateral tension pneumothorax with flattening of both diaphragmatic domes, reticular radiopacities, and mediastinal compression with a cardiac diameter of 11.1 and cardiothoracic index of 0.31 (Figure 1). The chest computed tomography (CT) scan demonstrates significant bilateral pneumothorax, with partial collapse of both lungs. This condition is attributed to pleural adhesions extending from the visceral pleura to the parietal pleura, preventing total lung collapse (Figure 2A). In the lung parenchyma, thin-walled cavitary lesions are located in the subpleural region of both upper lobes, suggestive of bullous disease (black arrows). Additionally, bronchiectasis, areas of consolidation, and zones of ground-glass opacity with a chronic appearance are observed (Figure 2B). In the lower lobes, there is evidence of passive atelectasis and a minimal left pleural effusion (Figure 2C). Due to a borderline ventilatory pattern with failure to oxygen therapy, a 26 Fr chest tube was placed in both hemithorax's.

The patient demonstrates a favorable clinical progression with partial expansion of both lungs. However, on the tenth day of hospitalization, complications arose in the form of a third-degree bronchopleural fistula (according to the Cerfolio classification) and bilateral hydropneumothorax (Figure 3). The patient is maintained with chest drainage tubes and a negative pressure system at 20 cm due to persistent recurrent collapse. A pleural fluid study was performed with negative results for empyema or TB. (ADA: 16 mg/dL). On the 30th day of hospitalization, a trapped lung was noted with resolution of the fistula (at 25 days) of the left hemithorax with removal of the chest tube. A Heimlich valve was placed in the right hemithorax (Figure 4). Due to improvement of symptoms and normalization of laboratory

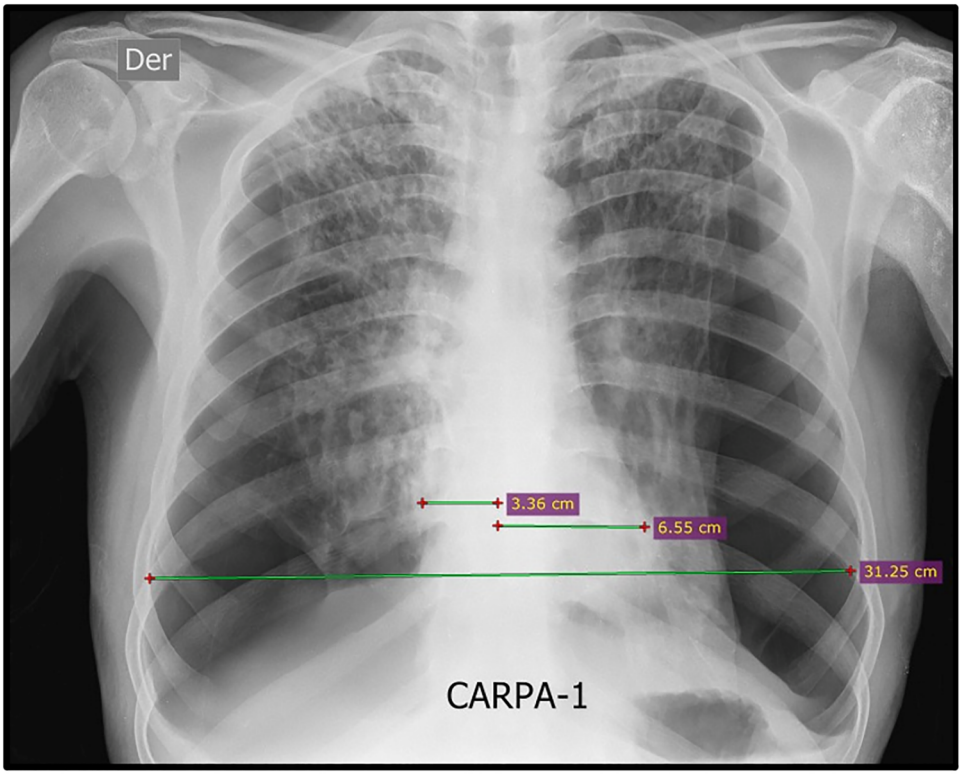

Figure 1. Chest x-ray showing the presence of bilateral tension pneumothorax.

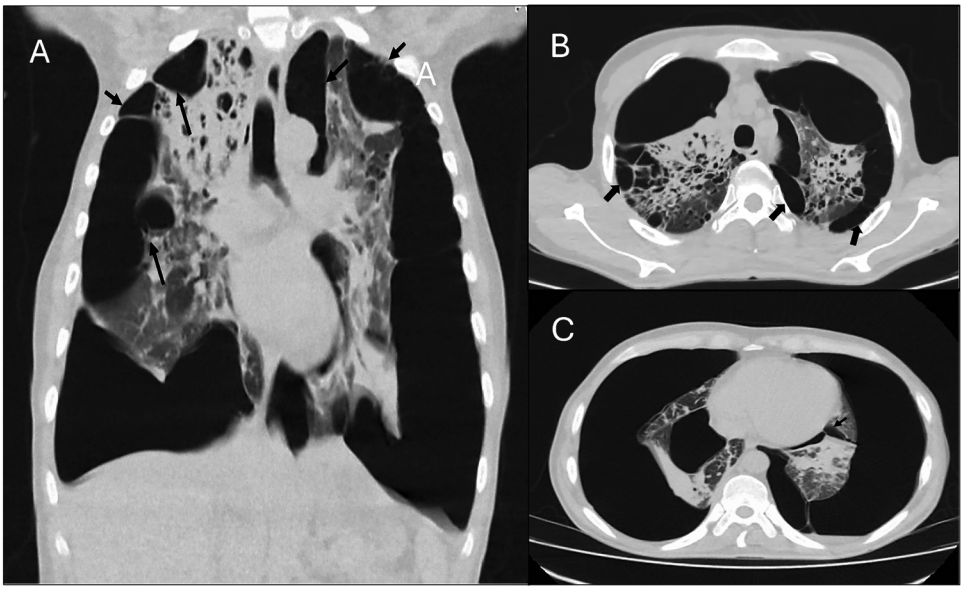

Figure 2. Chest computed tomography. (A) Coronal section displays bilateral pneumothorax and the presence of pleural adhesions. (B) Axial section—upper lobes, predominantly featuring thin-walled cavitary lesions and bronchiectasis. (C) Axial section—lower lobes, showing passive atelectasis and left pleural effusion.
Note: Presence of subpleural and pulmonary bullae (black arrow).

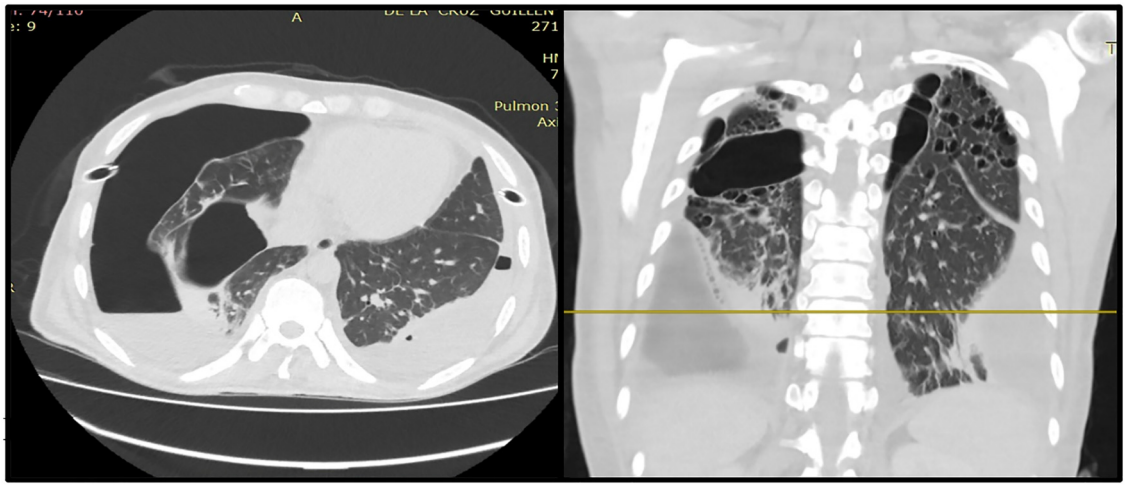

Figure 3. Chest computed tomography (CT). It demonstrates partial expansion of both lungs, a right bronchopleural fistula, and bilateral hydropneumothorax with thoracic drainage tubes positioned in the lower lobes.

tests, the patient was discharged, and TB treatment was continued on an outpatient basis.

Discussion

BLD in TB patients has been reported since the early 1950s,[5] generally in pediatric patients and with an unclear explanation about its pathophysiological mechanism. It was mainly proposed as a sequela of TB, due to the presence of cystic bronchiectasis with accumulation of secretions that can trigger destruction of the bronchial wall due to bacterial infections.[6,7] The cause of COPD is also known to be TB, which can trigger bullous emphysema.[8]

TB, during its inflammatory activity, can also cause the development of bullae, as postulated by pleural porosity, which conditions the formation of subpleural bullae by endothelial growth

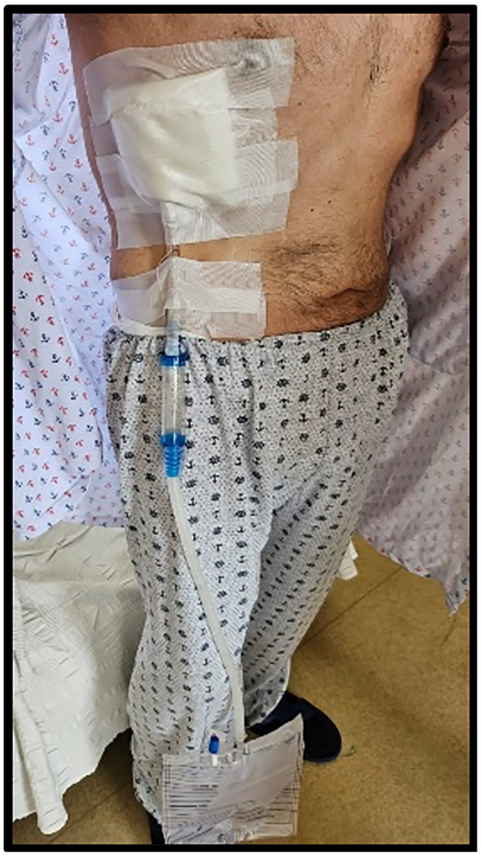

Figure 4. Heimlich valve placement.

mediators and transforming-β_1. Another mechanism is the entry of air into the interstitium due to the rupture of the tubercle and the tuberculous cavities lined by ciliated epithelium that form cysts. Finally, the use of isoniazid has been described as an antituberculosis drug involved in the induction of EBP.[9]

However, we should be able to dismiss that question: Should we include the use of INH in the treatment of TB, even though it is a cause of BDL?

The authors think so. First, TB in this combined process generates gasification and extensive excavations. That said, INH allows epithelialization of the bronchocavitary junction, allowing a permeable bronchus and the exit of gaseous material that can alter the alveolar walls, triggering bullae.[10] Second, we prevent future complications from INH penetration into TB granulomas, enhancing immune cell tolerability to high reactive oxygen species loads that cause necrotic cell death.[11] Thirdly, it has an indirect effect on bacterial growth through the regulation of cytokines (IL-1β and TNF) reducing the survival of TB.[12] On the other hand, there are reports of other anti-TB drugs that are causes of bullae.[13]

In patients with the presence of bullae, it must be essential to rule out TB, as untimely treatment may induce rapid progression of BLD with significant complications, as was the case in our patient, who developed bilateral tension pneumothorax and bronchopleural fistula. This could have led to a fatal outcome, with a mortality of more than 50%.[14] Negative sputum smear results and clinical suspicion should be sufficient to consider bronchoscopy with TB genotyping, as the presence of the TB bacillus in the blisters is reported.[15]

The management of this type of patients must be timely, in our case the placement of a chest tube and negative pressure allows partial expansion of the lung, however, the complication with bronchopleural fistula and repetitive collapses ended up generating a trapped lung. It is certainly challenging to achieve full recovery, so the use of chemical pleurodesis or video-assisted thoracoscopic surgery is suggested, with the possibility of surgical intervention at 3 months after starting anti-TB treatment.[14]

Conclusion

BLD due to TB should be treated early because there is a high risk of bullae rupture, which can cause pneumothorax and be complicated by bronchopleural fistulas. The use of INH should not be contraindicated, as it greatly benefits the treatment of BLD. It is necessary to place a chest tube and negative pressure according to the size of the fistula. Pleurodesis is likely to be required as pneumothorax may recur.

Ethics Approval

As a case report involving educational and medical activities, it was exempt from requiring approval by the Institutional Review Board of the "Hospital Nacional Dos de Mayo."

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. Likewise, written informed consent was obtained from the patient for publication in a scientific journal.

Author contribution(s)

Cristian Morán-Mariños: Conceptualization; Data curation; Investigation; Formal analysis; Methodology; Supervision; Validation; Writing – original draft; Writing – review & editing.
María Vidal-Ruiz: Conceptualization; Supervision; Visualization; Writing – original draft; Writing – review & editing.
Felix Llanos-Tejada: Investigation; Supervision; Validation; Writing – original draft; Writing – review & editing.
Antonella Chavez-Huamani: Methodology; Visualization; Writing – original draft; Writing – review & editing.
Juan Salas-Lopez: Investigation; Writing – original draft; Writing – review & editing.
Renzo Villanueva-Villegas: Methodology; Writing – original draft; Writing – review & editing.
Renato Casanova-Mendoza: Investigation; Validation; Writing – review & editing.
All authors reviewed the paper and approved the final version of the manuscript.

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Competing interests

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References

1. Ravimohan S, Kornfeld H, Weissman D, et al. Tuberculosis and lung damage: From epidemiology to pathophysiology. *Eur Respir Rev*. 2018; 27:170077. DOI: 10.1183/16000617.0077-2017
2. Aramini B, Ruggiero C, Stefani A, et al. Giant bulla or pneumothorax: How to distinguish. *Int J Surg Case Rep*. 2019;62:21-23. DOI: 10.1016/j.ijscr.2019.08.003
3. Pednekar P, Amoah K, Homer R, et al. Case report: Bullous lung disease following COVID-19. *Front Med*. 2021;8. DOI: 10.3389/fmed.2021.770778
4. Gagnier JJ, Kienle G, Altman DG, et al. The CARE guidelines: Consensus-based clinical case reporting guideline development. *Glob Adv Health Med*. 2013;2:38-43. doi:10.7453/gahmj.2013.008
5. Murphy JD, Piver JD. Cystic disease of the lung. *Dis Chest*. 1951;19:454-472. DOI: 10.1378/chest.19.4.454
6. Johari B, Khor BH, Musa AN, et al. Cystic lung disease as a complication of post-tuberculosis infection in young patients: A rare manifestation of a common disease. *Respirol Case Rep*. 2022;10: e0911. DOI: 10.1002/rcr2.911
7. Antonangelo L, Vargas FS, Puka J, et al. Pleural tuberculosis: Is radiological evidence of pulmonary-associated disease related to the exacerbation of the inflammatory response? *Clinics (Sao Paulo)*. 2012;67:1259-1263. DOI: 10.6061/clinics/2012(11)06
8. Fan H, Wu F, Liu J, et al. Pulmonary tuberculosis as a risk factor for chronic obstructive pulmonary disease: A systematic review and meta-analysis. *Ann Transl Med*. 2021;9:390. doi:10.21037/atm-20-4576
9. Ray A, Suri JC, Sen MK, et al. Cystic lung disease in tuberculosis: An unusual presentation. *Lung India*. 2013;30:351-353. DOI: 10.4103/0970-2113.120620
10. Matsaniotis N, Kattamis C, Economou-Mavrou C, et al. Bullous emphysema in childhood tuberculosis. *J Pediatr*. 1967;71:703-708. https://doi.org/10.1016/S0022-3476(67)80206-3
11. Khan SR, Manialawy Y, Siraki AG. Isoniazid and host immune system interactions: A proposal for a novel comprehensive mode of action. *Br J Pharmacol*. 2019;176:4599-4608. DOI: 10.1111/bph.14867
12. Yamashiro LH, Eto C, Soncini M, et al. Isoniazid-induced control of Mycobacterium tuberculosis by primary human cells requires interleukin-1 receptor and tumor necrosis factor. *Eur J Immunol*. 2016;46:1936-1947. https://doi.org/10.1002/eji.201646349. .
13. Alarcon DG. Regressive giant bullous emphysema in tuberculosis of adults. *Dis Chest*. 1955;27:31-43. DOI: 10.1378/chest.27.1.31
14. Chaudhry I, Bojal S, Attia A, et al. Multimodality management of extensive tuberculous bullous disease of lung with bilateral pneumothorax. *Ann Thorac Surg*. 2010;90:304-305. DOI: 10.1016/j.athoracsur.2009.12.077
15. Sarwar MH, Parmar K, Abohelwa MMA, et al. Infected Emphysematous Bullous Lung Disease Versus Active Pulmonary Tuberculosis, The Importance of Early Bronchoscopy. *TP99 TP099 Curious mycobacterial cases and mimickers*. pp.A4046-A4046.