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SHORT ABSTRACTS

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Imaging of Pulmonary Tuberculosis Made Easy

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Tuberculosis (TB) is a bacterial infection caused by *Mycobacterium tuberculosis*. It primarily affects the lungs, although it can spread to other organs. TB remains a global health challenge, with the World Health Organization estimating that nearly 10.6 million people became ill with TB in 2021 alone [1]. Chest imaging is a crucial component in the diagnosis, management, and monitoring of TB [2].

TERMINOLOGY

In primary tuberculosis (TB), the initial infection presents with consolidation, which can occur anywhere in the lungs, along with enlarged lymph nodes and pleural effusion. This infection often regresses into a calcified lung nodule and a calcified ipsilateral lymph node, which is indicative of healed primary TB [2]. Necrotizing lymphadenitis in TB is characterized by enlarged lymph nodes with central low attenuation and peripheral rim enhancement [3]. Secondary TB, also known as postprimary or reactivation TB, occurs when the original infection is reactivated, typically in the apical segments of the upper lobes. Secondary TB typically shows more pronounced features, such as cavitation due to tissue necrosis, poorly defined nodules representing active granulomas [3], and fibrosis and retraction, which lead to volume loss in the affected areas [3]. Endobronchial spread can occur in both primary and secondary TB when the infection is not contained. This appears as a tree-in-bud pattern, referring to centrilobular nodules with branching opacities, indicating bronchial spread of the infection [3]. It can occur in poorly contained primary infections, where extensive cavitation of tuberculous pneumonia causes endobronchial spread. The rupture of necrotic lymph nodes into the bronchi can also result in endobronchial dissemination. In miliary TB Figure 1 A-B, small 2–3 mm nodules are scattered randomly throughout the lung fields. These miliary nodules are characteristic of the hematogeneous spread of the TB infection [2].

IMAGING

Chest X-ray (CXR) is often the first-line imaging modality for evaluating suspected pulmonary TB. It is widely available, cost-effective, and provides quick results, making it a valuable tool, particularly in resource-limited settings [2]. Despite its utility, CXR has

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limitations, especially in detecting early or subtle disease. Computed tomography (CT) allows for a more detailed assessment and is particularly useful in cases where the CXR findings are inconclusive or when complications, such as abscesses or pleural involvement, are suspected [3]. CT imaging can reveal a spectrum of abnormalities, which include tree-in-bud pattern, miliary nodules, cavitary lesions Figure 1C, and lymphadenopathy. CT is also beneficial in evaluating complications such as bronchiectasis or aspergilloma, as well as extrapulmonary manifestations of TB, such as involvement of the pleura, chest wall, and mediastinum [4]. A decrease in cavitation size, reduction in nodular opacities, and resolution of pleural effusion are indicators of a positive treatment response [5]. However, it is important to note that resolution on imaging often lags behind clinical improvement [3]. The use of magnetic resonance imaging (MRI) is still limited in pulmonary TB due to its higher cost, limited availability, and longer acquisition times. MRI is particularly valuable in evaluating TB of the spine (Pott's disease) and the central nervous system [5]. In pulmonary TB, MRI can be useful in assessing complex cases involving the mediastinum, pleura, or chest wall. Furthermore, MRI has advantages in pregnant women and children where radiation exposure is a concern [4].

CONCLUSIONS

Imaging plays a pivotal role not only in the initial diagnosis of TB but also in assessing disease extent and monitoring treatment response. However, the interpretation of imaging findings should always be integrated with clinical and microbiological data to ensure accurate diagnosis and effective treatment [6].

COMPETING INTERESTS

The authors have no competing interests to declare.

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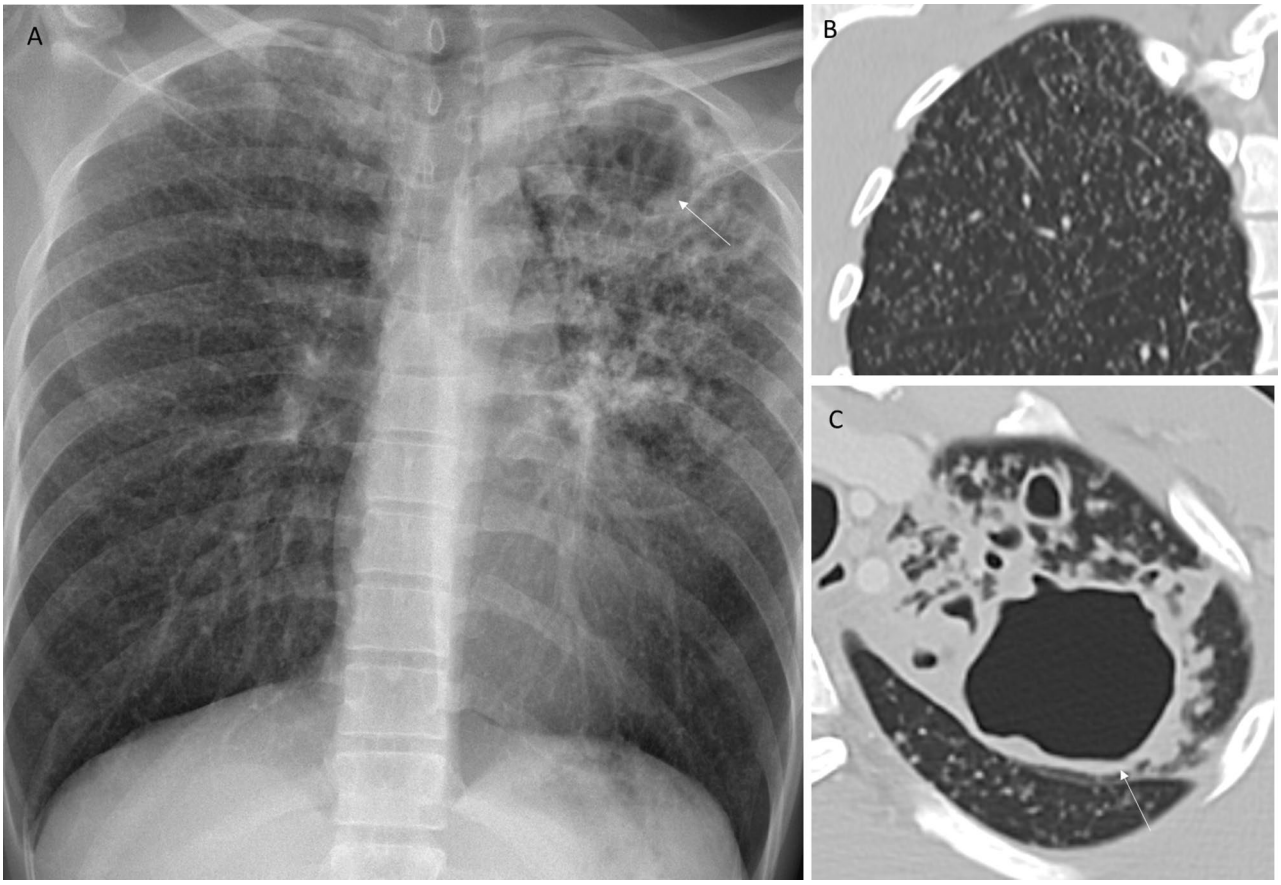

Figure 1 Chest X-ray (**A**), coronal CT image (**B**), and axial CT image (**C**) of a 25-year-old male with pulmonary tuberculosis. Multiple small nodules in random distribution, compatible with miliary tuberculosis, are depicted on X-ray (**A**) but in more detail on the CT image (**B**). The cavity (arrow) in the consolidation of the left upper lobe is detected on X-ray (**A**) but is better delineated on the CT image (**C**).

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