Thoracic manifestations of paradoxical immune reconstitution inflammatory syndrome during or after antituberculous therapy among HIV-negative patients

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ABSTRACT
Immune reconstitution inflammatory syndrome (IRIS) is a consequence of exaggerated and dysregulated host’s inflammatory response to invading microorganisms, leading to uncontrolled inflammatory reactions. IRIS associated with tuberculosis (TB) is well recognized among human immunodeficiency virus (HIV)-infected patients receiving highly active antiretroviral therapy, but it is less common among HIV-negative patients. IRIS can manifest as a paradoxical worsening or recurring of preexisting tuberculous lesions or development of new lesions despite successful antituberculous treatment. Hence, the condition might be misdiagnosed as superimposed infections, treatment failure, or relapse of TB. This pictorial essay reviewed diagnostic criteria and various thoracic manifestations of the paradoxical form of TB-associated IRIS (TB-IRIS) that might aid in early recognition of this clinical entity among HIV-negative patients. The treatment and outcomes of TB-IRIS were also discussed.

Diagnostic criteria
TB-IRIS is defined as a paradoxical worsening or recurring of preexisting tuberculous lesions or development of new lesions in patients receiving adequate anti-TB therapy and exhibiting initial improvement following the treatment. It can occur during or after completion of anti-TB therapy. Because of various clinical and radiologic manifestations, TB-IRIS might be misdiagnosed as superimposed infections, treatment failure secondary to inadequate anti-TB treatment, drug-resistant TB, or TB relapse. Hence, the diagnosis of TB-IRIS requires the following criteria: 1) initial improvement of TB-related symptoms and/or radiographic findings after adequate anti-TB treatment for a certain time; 2) paradoxical deterioration of TB-related symptoms and/or radiologic findings either at the primary or new locations during or after anti-TB treatment; 3) absence of conditions interfering with the efficacy of anti-TB drugs, e.g., poor compliance, drug malabsorption, or side effects from anti-TB drugs; and 4) lack of other explanations for clinical deterioration.
In equivocal cases, biopsy may be required to exclude other diseases, particularly malignancy or other infections (7, 8). Although acid fast bacilli stain or polymerase chain reaction assay for \textit{M. tuberculosis} can be positive (5), persistently active multidrug-resistant TB or other mycobacterial infections should not be discovered on culture of biopsied specimens obtained from the IRIS sites. However, due to high bacillary load in the IRIS abscesses, pus culture may grow \textit{M. tuberculosis} (9, 10).

Granulomas with or without chronic inflammation and necrosis are common in histopathologic analysis of TB-IRIS (5, 7). However, these findings can be found in other diseases including various infections (e.g., nontuberculous mycobacteria, fungi, and toxoplasmosis), sarcoidosis, extrinsic allergic alveolitis, Wegener granulomatosis, foreign body granuloma, and Kikuchi’s disease (11). Therefore, the histopathologic finding of granulomas should always be interpreted with other clinical indicators of TB-IRIS, e.g., robust microbiologic response and improvement without antimicrobial
Clinical and radiologic manifestations of TB-IRIS

TB-IRIS in HIV-negative patients is more frequent in extrapulmonary TB, notably in pleural and lymph node TB. The incidence varies from 2.4% to 25% (2, 3, 12). Predisposing factors for developing TB-IRIS include younger age, male gender, enlarging lymph nodes with local inflammation, anemia, and low lymphocyte count before treatment (2, 7). The median time to IRIS onset after initiating anti-TB drugs is typically within three months. Recurrent fever, enlarging lymph nodes and increasing dyspnea are the most common presenting symptoms (3).

Regardless of the sites of primary TB, TB-IRIS mainly involves the lymph nodes (68%) and lungs (16%) (2). Various thoracic manifestations in TB-IRIS include: new pulmonary parenchymal lesions (Figs. 1–3) (5, 7); enlarging preexisting lymphadenopathy or development of new lymphadenopathy (Figs. 3, 4) (3, 7, 8, 12); progression of preexisting pleural effusions or development of new pleural effusion (13, 14); development of new chest and abdominal wall lesions (Figs. 3, 5); and endobronchial lesions (Fig. 4). TB-IRIS usually develops ipsilateral to the side of primary TB, though contralateral or bilateral lesions can also occur (5).

Paradoxical enlargement of preexisting lymph nodes or development of new lymphadenopathy can occur in up to 25% of HIV-negative patients with peripheral TB lymphadenitis, but it is less common in those with TB meningitis and pulmonary TB (4). They usually develop within 4–14 weeks (mean, 8 weeks) after the initiation of anti-TB treatment. They can also develop within 1–13 months (mean, 3 months) after treatment completion (8, 12). Associated sinus discharge may be present.

New peripheral pulmonary nodules occur in 2.4%–11% of HIV-negative patients with pleural TB (5), and develop within three months (range, 1–9 months) after starting anti-TB therapy. Occasionally, they can develop after complete anti-TB therapy (5).
Computed tomography (CT) of the chest reveals single or multiple well- or ill-defined peripheral or pleural-based pulmonary nodules, which mostly occur ipsilateral to the pleural effusion (Figs. 1d, 1e, 2b, 2c, 3e). These nodules often abut normal or thickened pleura, contain a central low-attenuation (Figs. 1e, 2b, 2c, 3e), and usually vary 1–8 cm (mean, 3 cm) in diameter (5). These CT features may sometimes be indistinguishable from nontuberculous mycobacterial infection, rounded atelectasis, or malignancy. Unusual appearances such as new tree-in-bud opacities may also develop (Fig. 3c, 3f).

TB-IRIS presenting as a new or increased pleural effusion occurs in 16%–45% of HIV-negative patients with pleural (13, 14), lymph node (7), and pulmonary TB (4). In 80% of cases, effusions develop within 3–19 weeks of treatment initiation (14).

TB-IRIS presenting as new inflammatory or noninflammatory lesions within the skin, subcutaneous tissues, or muscles of the chest or abdominal wall is more frequently observed in HIV-negative patients with miliary or disseminated TB than in those with pleural and lymph node TB (Figs. 3d, 5c, 5d) (9, 10). After starting anti-TB treatment, lesions can occur within an average of three months (range, 17–202 days) (10), in isolation or coincident with enlarged lymph nodes or peripheral pulmonary masses (Fig. 3d, 3e).

TB-IRIS presenting as endobronchial lesions with or without associated obstruction (Fig. 4g, 4h) is rare. It can either be a newly developed paradoxical lymphadenitis with erosion or fistulation into the airways or a true de novo endobronchial paradoxical reaction (15).

**Treatment and outcomes**

Currently, there is no consensus regarding the standard treatment for TB-IRIS. Approximately half of the patients with TB-IRIS at lymph nodes experience spontaneous resolution (7). Because most of the *M. tuberculosis* strains in patients with TB-IRIS are susceptible to first-line anti-TB drugs, continuation of the standard treatment (isoniazid, rifampin, pyrazinamide, and ethambutol) for two months, followed by at least four months of isoniazid and rifampin is recommended (3). Alternative treatment is to prolong the course of anti-TB treatment to nine months, using the four drugs during the first 2–5 months, followed by isoniazid with one or two of the remaining drugs thereafter (5). Cho et al. (7) found no significant difference in relapse rates between 12 months and <9 months of treatment among patients with lymph node TB. Prolonged treatment may be required for patients with TB-IRIS involving the lymph nodes, main airways, and chest wall or having soft tissue abscesses. Treat-
ments lasting 12–27 months have been reported (5). Nevertheless, the optimal treatment duration remains debatable.

There is no recommendation for treatment of TB-IRIS that develops after the completion of initial anti-TB therapy. We observed a good response with re-treatment using the standard regimen, i.e., the combined four drugs in the first two months and isoniazid and rifampin in the following seven months. Most patients with TB-IRIS show clinical improvement in two months (range, 1–7 months) following the treatment (2). After 3–18 months of continued anti-TB treatment, lymphadenopathy and pulmonary lesions shrink or even disappear (Fig. 3g, 3h). However, the time needed for complete resolution is variable, and residual lesions may be observed (Fig. 2d). Delayed improvement with multiple recurrences can occur before complete resolution (2).

Depending on sites and severity of TB-IRIS, adjunctive therapy may be necessary. Patients with symptomatic pleural effusion generally require aspiration (14). Although soft-tissue abscesses heal within a few months, they can recur during or after treatment. In these circumstances, most patients require aspiration (10). Unlike pleural effusion and soft-tissue abscesses, only patients with severe paradoxical lymphadenopathy require aspiration (12).

Systemic corticosteroid administration for 4–6 weeks has been shown to be effective in HIV, symptomatic enlarging intracranial tuberculoma (16), and endobronchial obstruction (15), since it may reduce proinflammatory cytokines (16, 17). However, its role in other forms of TB-IRIS remains unclear.

The outcome of TB-IRIS in the thorax is favorable with a recovery rate of up to 95% (2, 12). Serious adverse sequelae or mortality is rare (4, 6).

Conclusion
Worsening or recurring preexisting tuberculous lesions or development of new lesions during or after anti-TB treatment should raise concern for TB-IRIS. Currently, the mainstay of treatment is continuation of anti-TB drugs. However, the optimal treatment duration remains debatable and should be individualized based on primary TB type and clinical response.

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References


