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Clinical Characteristics of Tuberculosis Among People Living with Human Immunodeficiency Virus (HIV): A Multicenter Study

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ABSTRACT

Objective: The intersection of human immunodeficiency virus (HIV) and tuberculosis (TB) presents a significant public health challenge, particularly in regions with high prevalence of both diseases. This multicenter, retrospective study aimed to evaluate the clinical characteristics, treatment outcomes, and factors influencing the development of TB in individuals infected with HIV.

Materials and Methods: This multicenter, retrospective study included individuals infected with HIV from 15 centers, assessing demographic and disease-related data. Inclusion criteria encompassed HIV patients over 18 years of age with TB treatment histories. Data analysis utilized SPSS Statistics version 25.0, adhering to the ethical principles of the Declaration of Helsinki.

Results: The study included 9,720 HIV-infected patients from 15 centers, with TB detected in 124 (1.28%) of these individuals. The majority were male, and the median age at TB diagnosis was 43 years. Clinical findings revealed that pulmonary TB was the most common form (69.4%), with weight loss, cough, and fever as prevalent symptoms. The study also noted a significant delay in TB diagnosis, with a median symptom duration of 60 days. Only six patients exhibited resistance to TB medications. The most commonly used antiretroviral treatment regimen was tenofovir disoproxil fumarate/emtricitabine/dolutegravir (TDF/FTC/DTG). Immune reconstitution inflammatory syndrome (IRIS) developed in 12.1% of patients. Despite these challenges, 79.8% of patients successfully completed TB treatment. However, mortality was observed in 11.3% of cases.

Conclusion: The study highlighted the need for improved screening and prophylaxis for latent TB in individuals infected with HIV, especially those with low CD4+ T lymphocyte counts. The results underscore the importance of timely diagnosis and careful management of HIV-TB co-infection to reduce morbidity and mortality.

Keywords: Antiretroviral therapy, co-infection, human immunodeficiency virus (HIV), immune reconstitution inflammatory syndrome (IRIS), tuberculosis.

INTRODUCTION

The intersection of human immunodeficiency virus (HIV) and tuberculosis (TB) epidemics presents a significant public health challenge, particularly in regions with high prevalence of both diseases. HIV, a retrovirus responsible for acquired immunodeficiency syndrome (AIDS), has exacerbated the TB epidemic by significantly increasing the risk of reactivation of latent Mycobacterium tuberculosis infection and progression to active TB disease. TB is the most common serious opportunistic infection among people living with HIV (PLHIV).[1]

HIV infection alters the natural history and clinical presentation of TB, leading to more severe and disseminated forms of the disease. Co-infected individuals often present with atypical and more severe TB manifestations due to their compromised immune systems. The synergistic interaction between HIV and M. tuberculosis exacerbates the decline in immune function, accelerating disease progression and increasing mortality rates. This co-infection has emerged as a major cause of morbidity and mortality globally, with HIV-1 co-infection being the single greatest risk factor for developing active TB.[2]

The clinical management of HIV and TB co-infection is complex due to overlapping drug toxicities and interactions between antiretroviral therapy (ART) and anti-TB medications. The initiation of ART in patients undergoing TB treatment can provoke immune reconstitution inflammatory syndrome (IRIS), complicating the clinical picture. Despite these challenges, early initiation of ART is crucial for improving survival rates among co-infected patients. Optimal management requires a careful balance of timely ART initiation and effective TB treatment to mitigate the risks of drug interactions and adverse effects.[3]

The purpose of this study was to evaluate the demographic, clinical, and treatment characteristics of individuals infected with HIV co-infected with tuberculosis across multiple centers to better understand the prevalence, clinical presentation, and outcomes of TB in this population.

MATERIALS AND METHODS

This research was designed as a multicenter, retrospective, descriptive study. The study included 15 centers: six universities and nine training and research hospitals. The study population consisted of 9,720 individuals infected with HIV who were followed up by these centers until May 15, 2024. All patients meeting the inclusion criteria were included in the study without randomization. Demographic and disease-related data of the patients were obtained from hospital automation systems.

All male and female patients infected with HIV, over 18 years old, who presented to the infectious diseases and clinical microbiology outpatient clinic, were followed up as outpatients or inpatients, diagnosed with TB, continuing TB treatment, completed treatment, or discontinued treatment were included in the study. Patients whose clinical data were not accessible and those under 18 years old were not excluded from the study.

- Immune Reconstitution Inflammatory Syndrome (IRIS): IRIS describes a severe reaction to TB bacilli and/or antigens resulting from immune system improvement after ART. Cases were considered IRIS if new, worsening, or recurrent clinical and radiological findings of TB were observed one to four weeks after starting ART in a patient naive to ART who showed clinical improvement with TB treatment. Additionally, patients who had not yet been diagnosed with TB at the time ART was initiated and who developed clinical and radiological findings of TB after starting ART were also included in the IRIS group.[4]
- Mortality: The in-hospital mortality rate from all causes was calculated to determine the crude mortality rate.

Throughout the inclusion of patients in the study and the processes of data collection, analysis, and reporting, the greatest care was taken to protect individuals' privacy and rights; adherence to the Declaration of Helsinki and Good Clinical Practice Guidelines was maintained. Local ethics committee approval for the study was obtained on April 15, 2024 (HNEAH-KAEK 2024/56).

Data were evaluated using the IBM Statistical Package for the Social Sciences (SPSS) Statistics 25.0. Descriptive statistics were reported as unit number (n), percentage (%), mean±standard deviation ($\bar{x}$±SD), and median (Q1–Q3) values. Pearson's Chi-Square and Fisher's exact tests were used for the evaluation of categorical variables. The normal distribution of continuous variables was assessed with the Shapiro-Wilk normality test and Q-Q plots. For comparison of continuous variables between two groups, the Independent Samples T-test was used for normally distributed variables, and the Mann-Whitney U test was used for non-normally distributed variables. A p-value of less than 0.05 was considered statistically significant.

KEY MESSAGES

- This multicenter study highlights the clinical and demographic characteristics of human immunodeficiency virus (HIV) and tuberculosis (TB) coinfection, emphasizing the prevalence of pulmonary TB, delayed diagnosis, and high treatment success rates.
- Key findings include the association of low CD4+ T lymphocyte levels with increased TB risk, the emergence of immune reconstitution inflammatory syndrome (IRIS) in a significant number of cases, and the effectiveness of combined antiretroviral therapy and anti-TB treatment.
- These results underscore the importance of timely diagnosis and management of coinfection to reduce morbidity and mortality.

Table 1. Demographic characteristics of patients

	n	%
Gender (n=124)		
Male	106	85.5
Female	18	14.5
Social habits (n=124)		
Smoking	63	50.8
Alcohol	37	29.8
Illegal drugs	16	12.9
Communal living (n=119)	6	5.0
Comorbidities (n=75)		
Diabetes mellitus	8	6.5
Chronic lung disease	5	4.0
Cardiovascular diseases	4	3.2

RESULTS

In this study, TB disease was detected in 124 (1.28%) of 9,720 individuals infected with HIV. The median age at TB diagnosis was 43 years (36–52), with 85.5% of the study group being male. At least one comorbidity was observed in 12% of cases, with diabetes mellitus being the most common (6.5%). Among the patients, 50.8% reported smoking, 29.8% reported alcohol use, and 12.9% reported drug use. Additionally, 10.3% of the patients were identified as migrants or refugees, and 5% were found to be living in communal environments. No patients diagnosed with TB during pregnancy were found (Table 1).

Table 2. Clinical and laboratory results of patients

	n	%		n	%
TB contact (n=75)	11	8.9	Computed tomography findings (n=103)		
History of TB prophylaxis (n=124)	3	2.4	Consolidation	32	31.1
BCG vaccine (n=97)	78	80.4	Miliary involvement	21	20.4
Type of tuberculosis (n=124)			Normal	16	15.5
Pulmonary	86	69.4	Cavitary lesion	12	11.7
Miliary	17	13.7	Nodular lesion	9	8.7
Lymphadenitis	12	9.7	Lymphadenopathy	6	5.8
Pleura	3	2.4	Ground glass opacity	4	3.9
Meningitis	2	1.6	Pleural effusion	3	2.9
Pulmonary + meningitis	2	1.6	TB PCR results (n=81)		
Urinary	1	0.8	Positive	65	80.2
Osteomyelitis	1	0.8	Negative	16	19.8
Chest X-ray findings (n=87)			Acid-fast staining (n=117)		
Normal	32	36.8	Positive	62	53.0
Non-specific infiltration	23	26.4	Negative	55	47.0
Cavitary lesion	12	13.8	TB culture results (n=105)		
Miliary involvement	11	12.6	*M. tuberculosis* complex	71	67.6
Nodular lesion	7	8.0	No growth	34	32.4
Pleural effusion	2	2.3	TST results (n=65)		
Cranial MRI findings (n=51)			11 mm and above	29	44.6
Normal	36	70.6	Anergic	26	40.0
Cerebral toxoplasmosis	4	7.8	1–5 mm	6	9.2
Hyperintense lesion	3	5.9	6–10 mm	4	6.2
Tuberculoma	2	3.9	IGRA results (n=38)		
Cerebral atrophy	2	3.9	Negative	16	42.1
Ischemic changes	2	3.9	Positive	16	42.1
Venous angioma	1	2.0	Indeterminate	6	15.8
Hydrocephalus	1	2.0	Pathology findings (n=25)		
			Necrotizing granulomatous inflammation	18	72.0
			Non-specific inflammation	7	28.0

TB: Tuberculosis; BCG: Bacillus Calmette-Guérin; MRI: Magnetic resonance imaging; PCR: Polymerase chain reaction; TST: Tuberculin skin test; IGRA: Interferon-gamma release assay.

In 65.3% of the cases, TB was diagnosed simultaneously with HIV infection. The median time to the onset of TB symptoms after HIV infection was 12 months (4–42). At the time of TB diagnosis, the median CD4+ T lymphocyte count and HIV RNA level were 152/µl (40–338) and 291,500 IU (14,745–1,524,855), respectively.

The median duration of TB-related symptoms was 60 days (30–90 days). Weight loss was observed in 82.6% of cases, followed by cough (81.8%) and fever (71.8%). The most commonly reported form of tuberculosis was pulmonary TB (69.4%), followed by miliary TB (13.7%) and TB lymphadenitis (9.7%) (Table 2).

A history of TB contact was present in 8.9% of the cases. The Bacillus Calmette-Guérin (BCG) vaccine was administered to 80.4% of the patients, and a tuberculin skin test (TST) greater than 10 mm was found in 44.6% of cases. An interferon-gamma release assay (IGRA) was performed on only 38 patients, with positivity detected in 42.1% of them. Necrotizing granulomatous inflammation was found in 72% of the 25 cases that underwent histopathological evaluation. Pathological findings were detected in 63.2% on posteroanterior (PA) chest X-ray, 29.4% on cranial magnetic resonance imaging (MRI), and 28.9% on thoracic computed tomography (CT). TB polymerase

chain reaction (PCR) was positive in 80.2% of the patients, and acid-fast (AF) staining was positive in 53% of the cases. TB culture was performed in 105 patients, with M. tuberculosis growth detected in 67.6% of these patients (Table 2).

The standard anti-tuberculosis regimen (Isoniazid + Rifampicin + Pyrazinamide + Ethambutol) was used in 87% of cases. Rifabutin was preferred over rifampicin in ten patients. The most common drug-related side effect was hepatotoxicity (15.4%). Treatment was stopped in 12 patients due to side effects; however, treatment was resumed in 11 patients after 15 days and in one patient after two months. The duration of TB treatment varied, with 49% of patients completing a 6-month regimen, 20.3% receiving 12-month treatment, and 18.7% receiving 9-month treatment. Drug resistance was found in six of the 95 patients tested (Table 3).

Among the antiretroviral treatment regimens, Tenofovir Disoproxil Fumarate + Emtricitabine + Dolutegravir (TDF/FTC/DTG) was the most commonly used, at 65%. After the diagnosis of TB, 16.9% of the patients underwent changes in their antiretroviral treatment (Table 3).

Prophylaxis for TB was used in 2.4% of cases. Among the patients who were not given prophylaxis despite having an indication, the median CD4+ T lymphocyte count was 312/µL (107–429), and the median HIV-RNA level was 112,362 IU (12,626–767,557). The median time to TB diagnosis for these patients was found to be 40 months (3–48).

IRIS developed in 12.1% (n=15) of cases, with 80% (n=12) of these patients receiving steroid treatment. The median CD4+ T lymphocyte count in patients diagnosed with IRIS was 73/µL (29–320), and the median HIV-RNA level was 879,000 IU (1,926–3,900,000). TB was diagnosed significantly earlier in patients with IRIS compared to others (Table 4).

The majority of patients (79.8%) successfully completed TB treatment. Mortality occurred in 14 (11.3%) patients who died before completing their treatment. Seven patients were still undergoing treatment during the study, two patients were lost to follow-up, and one patient experienced a relapse.

DISCUSSION

In our country, the prevalence of HIV positivity among TB cases has shown a significant increase from 0.1% to 1% over the past decade.[5] The prevalence of HIV and TB coinfection varies between 3.2% and 6.26% in different regions of the world.[6–9] There are very few studies on this topic in our country. In two single-center studies, Bahçeci et al.[10] reported a 3.1% frequency of HIV and TB coinfection, while Zerdali et al.[11] reported a frequency of 5.3%. In this multicenter study presented here, TB was detected in 1.28% of PLHIV, which is considerably

Table 3. Treatments given to the patients

	n	%
Antiretroviral treatment regimen (n=117)		
TDF/FTC/DTG	76	65.0
ABC/3TC/DTG	8	6.8
TDF/FTC/EFV	7	6.0
TAF/FTC/BIC	7	6.0
TDF/FTC/RAL	6	5.1
TDF/FTC/EVG/c	4	3.4
3TC/DTG	3	2.6
TDF/FTC/LPV/r	3	2.6
TAF/FTC/EVG/c	2	1.7
3TC/ZDV/RAL	1	0.9
TB treatment regimen (n=123)		
Isoniazid + Rifampicin + Pyrazinamide + Ethambutol	107	87.0
Isoniazid + Rifabutin + Pyrazinamide + Ethambutol	9	7.3
Isoniazid + Rifampicin + Ethambutol + Moxifloxacin	2	1.6
Isoniazid + Rifampicin + Pyrazinamide + Ethambutol + Moxifloxacin	2	1.6
Isoniazid + Ethambutol + Moxifloxacin + Cycloserine	1	0.8
Isoniazid + Rifampicin + Ethambutol + Streptomycin	1	0.8
Isoniazid + Rifabutin + Ethambutol + Moxifloxacin	1	0.8
TB drug resistance (n=95)		
No resistance	89	93.7
Isoniazid	2	2.1
Pyrazinamide	2	2.1
Rifampicin	1	1.1
Streptomycin	1	1.1
Treatment duration (n=123)		
6 months	49	39.8
12 months	25	20.3
9 months	23	18.7
Treatment not completed	14	11.4
Treatment ongoing	7	5.7
7 months	2	1.6
Lost to follow-up	2	1.6
8 months	1	0.8
Side effects (n=123)		
Hepatotoxicity	19	15.4
Skin rash	3	2.4
Neuropathy	1	0.8
Hypersensitivity	5	4.1

TB: Tuberculosis.

Table 4. Comparison of clinical characteristics and outcomes in patients with and without immune reconstitution inflammatory syndrome (IRIS) development

	IRIS absent	IRIS present	p
Age (years)	45 (32–49)	40.5 (30–44)	0.192
Time to TB diagnosis (months), median	24.0 (6–46)	1.5 (1–7)	0.006
HIV-RNA at diagnosis, median	26,464 (0–950,145)	1,883,788 (1,451–4,473,327)	0.582
CD4+ T cell count at diagnosis, median	169 (37–288)	140 (39.5–496)	0.538
CD8+ T cell count at diagnosis, median	616 (299–902)	546 (277–1,076)	0.568
Gender, n			0.890
Male	93	13	
Female	16	2	
Type of tuberculosis, n			0.230
Extrapulmonary	31	7	
Pulmonary	78	8	

IRIS: Immune reconstitution inflammatory syndrome; TB: Tuberculosis; HIV: Human immunodeficiency virus.

lower than the prevalence found in national and international studies. This result may be influenced by data from regions with different TB incidences. There remains a need for studies on HIV and TB prevalence that represent all regions of our country.

According to the Ministry of Health, 15.9% of TB cases and 16.17% of HIV cases occur among foreign nationals.[5,12] In our study group, 10.3% of the participants were migrants or refugees. Due to the lack of previous national data on the frequency of TB and HIV coinfection in this population, no direct comparison could be made. However, based on Ministry of Health data, this rate appears to be lower than expected.

In this study group, the median duration of TB-related symptoms was 60 days (30–90). Symptoms lasting one month or more before TB diagnosis are defined as delayed diagnosis.[13] According to this definition, our cases were diagnosed late. Factors such as age of 50 years or older, intravenous drug use, lack of ART use, disseminated TB, and weight loss have been found to contribute to delayed diagnosis.[13] A significant portion of our cases were diagnosed with HIV simultaneously and, therefore, could not use ART. Additionally, weight loss and miliary TB were frequently detected. These factors may have contributed to the delay in diagnosis.

Weight loss, particularly wasting syndrome (defined as a loss of more than 10% of body weight), is common in advanced HIV infection. Among people living with HIV, significant weight loss can affect around 20% to 30% of individuals in the later stages of the disease, especially before the advent of antiretroviral therapy. Even with treatment, some patients continue to experience weight loss, particularly those with low CD4 counts.[14] Weight loss is particularly severe in individuals co-infected with both HIV and TB, where the rate of weight loss is accelerated due to the compounded effects of both diseases.[15] Weight loss was one of the most commonly reported symptoms, alongside cough and fever. This aligns with findings from the aforementioned studies, which show that co-infection heightens the inflammatory response and energy expenditure while leading to nutrient malabsorption, further intensifying wasting compared to either disease alone. Tuberculosis is the most common AIDS-defining illness (38%) among HIV-positive individuals in our country.[16] In our study, the average CD4+ T lymphocyte count at the time of TB diagnosis was in the AIDS stage according to national guidelines, with 25% of the patients having a count of 40 cells/µL, categorizing them in the advanced stage.[17] Approximately two-thirds of the cases were diagnosed with HIV and TB coinfection simultaneously, while in others, TB symptoms appeared after a median of 12 months. We believe it would be beneficial to closely monitor patients with a CD4+ T lymphocyte level below 200 cells/µL for TB findings at every stage following HIV diagnosis.

Factors influencing the development of TB in PLHIV vary across studies. Male gender, illegal drug use, low CD4+ T lymphocyte level, high HIV RNA level, and non-use of isoniazid prophylaxis are frequently cited risk factors for TB development.[6–9,11,18] In our study group, the number of male cases was higher, and the average CD4+ T lymphocyte level was below 200 cells/µL. Additionally, prophylaxis use was notably low. Although alcohol or illegal drug use was low, approximately half of the patients smoked. Qi et al.[7] reported that smoking increased the risk of HIV and TB coinfection by 1.6 times in China. Age

is not commonly considered a risk factor for TB development, though one study found a 1.4-fold increase in TB cases in the 30–45 age range, while another found a 2.7-fold increase among those aged 40 years and older.[7,18] The average age of our patients was 43, placing them in the high-risk age group according to both studies.

Guidelines recommend screening and treatment for latent TB infection (LTBI) and re-screening for individuals with CD4+ T lymphocyte levels above 200 cells/μL if initial screening tests are negative to prevent HIV and TB coinfection.[4,19,20] A study in Switzerland found the sensitivity of the TST or IGRA to be 20% and the specificity to be 95% in HIV-positive individuals, emphasizing that negative screening tests cannot fully exclude TB infection.[21] In our study group, TST was less than 5 mm in about half of the cases, and IGRA was negative or indeterminate in more than half. We believe that a significant number of LTBI cases might have been missed with these screening tests.

Wondmeneh et al.[8] reported that TB development is 3.3 times more frequent without isoniazid prophylaxis, and Ajema et al.[6] found it to be 6.2 times more frequent. In our study group, a significant portion of those who underwent screening tests did not receive prophylaxis despite having an indication. In this group, TB was diagnosed on average 40 months after HIV. Although an immunological response was achieved in most cases at the time of TB diagnosis, a virological response was lacking. This result suggests that it is essential to monitor for TB over a long period, especially in cases without virological response, and relying solely on the strong effect of ARTs or patient compliance to avoid TB prophylaxis can be misleading. Studies suggest that isoniazid-based regimens are effective in preventing TB; however, some patients still develop active TB even with prophylactic treatment, particularly in high-burden settings or where treatment adherence is poor.[22] In our study, three patients developed active TB despite receiving prophylaxis. Although TB incidence has decreased to 10.6 per 100,000 in our country, HIV positivity among TB cases has increased tenfold over the years.[5] Therefore, careful individual assessments in the diagnosis and treatment of LTB would be beneficial.

The frequency of HIV and extrapulmonary TB (EPTB) coinfection in our country is 34.2%, while it ranges between 40% and 84.5% in other countries.[11,23–25] Compared to pulmonary TB in PLHIV, miliary TB and TB meningitis are 1.5 and 1.7 times more common, respectively, in HIV-negative individuals.[26] EPTB constituted 30.6% of our study group, with the frequency of miliary TB being notable. While our frequency of EPTB is higher than in some international studies, it aligns closely with national data. Treatment is administered with appropriate agents for the standard duration based on the type of TB and susceptibility results. Drug interactions between HIV and TB medications require careful attention, as rifampicin induces the CYP450 system, causing a reduction in the levels of ART drugs. Tenofovir alafenamide, rilpivirine, etravirine, elvitegravir-cobicistat, bictegravir, and maraviroc are not recommended for use with rifampicin. If dolutegravir and raltegravir are used with rifampicin, their doses should be doubled. These integrase inhibitors and protease inhibitors can be safely used with rifabutin.[4,20] In this study, most patients received a standard regimen, with rifabutin used in ten cases to avoid drug-drug interactions. Treatments were mostly administered for the standard duration; however, 11.4% of cases did not complete the planned duration. The combination of TDF/FTC/DTG was the most frequently used ART. ART modifications were made for patients initially on non-recommended regimens after TB diagnosis.

Resistance rates in new TB cases in our country are 10.1% for isoniazid, 2.4% for rifampicin, 2.7% for ethambutol, and 8.6% for streptomycin.[5] In HIV and TB coinfection cases in China, resistance rates for isoniazid, rifampicin, ethambutol, and streptomycin were 11.5%, 15.1%, 12.5%, and 26.6%, respectively.[27] In our study, drug susceptibility testing was performed in most patients, but only a few resistant isolates were detected. This may be due to the low resistance rates in our country. An increase in aspartate transferase levels is seen in 20% of TB treatment cases, along with potential gastrointestinal complaints and skin rashes.[4] Rego de Figueiredo et al.[23] found hepatotoxicity (53%) and rash (21%) to be the most common side effects in HIV-TB coinfected patients. In our study group, hepatotoxicity was also the most common drug side effect. Although side effects temporary interrupted treatment, they did not prevent its completion.

Immune reconstitution inflammatory syndrome can occur in active TB cases with a probability of 8–40%.[4] Yang et al.[28] reported that IRIS emerged on average 15 days after ART initiation in 18.8% of patients, with age ≤40 years, CD4+ T lymphocyte count ≤50 cells/μL, and HIV RNA ≥500,000 copies/mL increasing the risk of IRIS. In a randomized study, IRIS was found at a frequency of 10.6%, with a CD4+ T lymphocyte count ≤100 cells/μL, HIV RNA ≥500,000 copies/mL, and the presence of EPTB or disseminated TB identified as risk factors associated with IRIS.[29] In 12.1% of our cases, IRIS developed. Unlike other studies, our study found that IRIS development increased in cases with a shorter time to TB diagnosis.

Approximately one-tenth of the patients in our study were lost before completing their treatment. Mortality within the first year after starting TB treatment ranges between 13–17.7%.[24,25] These studies found a higher frequency of mortality compared to our findings, and similar to our results, most mortality occurred before treatment completion.

This study has some limitations. Firstly, despite representing centers and regions of different sizes, the relatively small number of cases is a significant limitation. Additionally, due to the absence of a control group, factors facilitating the development of TB in individuals with HIV could not be determined. However, to our knowledge, our study is the most comprehensive national clinical study containing real-life data. The data obtained aim to raise awareness among physicians managing TB patients about HIV-TB coinfection, highlight ongoing practices in clinics, and identify areas for improvement. These results serve as the foundation for planning larger and more detailed studies.

CONCLUSION

In conclusion, despite the decrease in TB incidence in our country, the rapid increase in the number of PLHIV has led to a rise in TB coinfections. It would be beneficial to reevaluate the current clinical procedures for assessing the need for TB prophylaxis and its application. HIV-positive individuals at high risk of developing TB, IRIS, and mortality require closer monitoring. As the disease course may differ and diagnosis and treatment may be more complex in PLHIV, this process should be managed more carefully than in HIV-negative individuals. There is a need for large-scale clinical studies and guidelines that identify factors influencing the development of TB, IRIS, and mortality, and establish national HIV-TB coinfection management criteria.

Ethics Committee Approval: The Haydarpaşa Numune Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 15.04.2024, number: HNEAH-KAEK 2024/56).

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