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A Clinical Score for the Detection of Tuberculosis Among Patients with HIV Infection

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Abstract

Background: ***Objective***: To evaluate the diagnostic performance of a clinical tuberculosis (TB) scoring system among patients with HIV infection and compare its accuracy with conventional screening and microbiological methods. ***Study Design***: Cross-sectional diagnostic accuracy study. ***Place and Duration of Study***: Department of General Medicine, Shri B.M. Patil Medical College Hospital and Research Centre, BLDE (Deemed to be University), Vijayapura, Karnataka, from March 2024 to December 2025. ***Methodology***: Seventy HIV-infected adults were enrolled consecutively. All participants underwent TB score calculation based on symptoms, clinical signs, and anthropometric measurements. Standardized evaluation including chest radiography, sputum acid-fast bacilli (AFB) microscopy, and Xpert MTB/RIF testing was performed irrespective of symptom status. Tuberculosis diagnosis was established using a composite reference standard incorporating microbiological confirmation and clinical-radiological diagnosis. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Correlation between TB score and CD4 count was analyzed using Pearson correlation. ***Results***: The mean age was 45.37 ± 11.16 years, with 55.7% males. Tuberculosis prevalence was 27.1%. TB score >2 demonstrated 100% sensitivity, 55.4% specificity, 14.7% PPV, and 100% NPV. No TB cases were detected among patients with TB score ≤2 (51.4% of cohort). Sputum AFB positivity was 5.7%, while Xpert MTB/RIF detected 7.1%. A statistically significant negative correlation was observed between TB score and CD4 count ($r = -0.307$, $p = 0.010$). ***Conclusion***: The clinical TB scoring system showed excellent rule-out performance with perfect sensitivity and NPV, enabling safe exclusion of active TB in over half of HIV-infected patients. Its simplicity and feasibility make it suitable for implementation in resource-limited settings to optimize TB screening and preventive therapy decisions.

Keywords: Tuberculosis, HIV, Clinical scoring system, Diagnostic accuracy, CD4 count, Screening.

INTRODUCTION

Tuberculosis remains the leading cause of mortality among people living with HIV. HIV infection significantly increases the risk of progression from latent to active TB and alters clinical presentation, often resulting in smear-negative, atypical, or extrapulmonary disease [1]. These diagnostic challenges are particularly pronounced in resource-limited settings where access to advanced molecular testing is restricted [2].

Conventional sputum microscopy has reduced sensitivity in immune compromised individuals due to low bacillary burden. Although molecular assays such as Xpert MTB/RIF have improved detection rates, their availability and cost remain limiting factors [3]. Consequently, clinical prediction models and scoring systems have gained attention as practical tools to guide risk stratification and optimize diagnostic resource utilization [4].

Symptom-based screening algorithms recommended by international guidelines demonstrate high sensitivity but limited specificity, resulting in large numbers requiring confirmatory testing [5]. Clinical scoring systems incorporating symptoms, examination findings, and simple anthropometric measures may enhance risk classification and improve diagnostic efficiency [6-10].

This study aimed to evaluate the diagnostic performance of a clinical TB scoring system among HIV-infected patients and compare its effectiveness with microbiological methods in a tertiary care setting.

METHODOLOGY

This cross-sectional diagnostic accuracy study was conducted at the Department of General Medicine, Shri B.M. Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, between March 2024 and December 2025. Seventy HIV-infected adults aged >18 years were enrolled consecutively after obtaining informed consent. Patients who had received anti-tubercular therapy within the past year, were pregnant, or had incomplete clinical data were excluded. All participants underwent comprehensive clinical evaluation.

The TB score was calculated using a standardized scoring system based on five symptoms (cough, hemoptysis, chest pain, dyspnea, night sweats) and six clinical signs including fever (>37°C), tachycardia (>90 bpm), anemic conjunctivae, abnormal lung auscultation, reduced mid-upper arm circumference, and low body mass index. The maximum score was 13.

All patients underwent chest radiography, sputum AFB microscopy (Ziehl–Neelsen staining), and Xpert MTB/RIF testing when sputum was available. Final TB diagnosis was established using a composite reference standard incorporating microbiological confirmation and clinical-radiological judgment. Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequency and percentage. Sensitivity, specificity, PPV, and NPV were calculated. Pearson correlation assessed the relationship between TB score and CD4 count. A p-value <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee.

RESULTS

Seventy patients were included in the study. The mean age was 45.37 ± 11.16 years, with the majority (64.3%) between 41–60 years. Males constituted 55.7% of the study population. Only 4.3% were aged 18–20 years, while 7.1% were older than 60 years. Males constituted 55.7% of the cohort. Regarding duration of HIV infection, 32.9% had been diagnosed for 6–10 years, 24.3% for 1–5 years, 20.0% for more than 10 years, and 5.7% for less than one year; 17.1% were newly detected cases. The mean CD4 count was 347.34 ± 261.92 cells/mm³. Approximately one-third (34.3%) had severe immunosuppression with CD4 ≤200 cells/mm³, while 28.6% had CD4 counts >500 cells/mm³.

Table I: Baseline Demographic and Clinical Characteristics (n = 70)

Variable	Category	n (%) / Mean ± SD
Age (years)	—	45.37 ± 11.16
	18–20	3 (4.3%)
	21–40	17 (24.3%)
	41–60	45 (64.3%)
	>60	5 (7.1%)
Gender	Male	39 (55.7%)
	Female	31 (44.3%)
HIV Duration	<1 year	4 (5.7%)
	1–5 years	17 (24.3%)
	6–10 years	23 (32.9%)
	>10 years	14 (20.0%)
	Newly detected	12 (17.1%)
CD4 Count (cells/mm³)	—	347.34 ± 261.92
	≤200	24 (34.3%)
	200–350	17 (24.3%)
	351–500	9 (12.9%)
	>500	20 (28.6%)

The mean TB score was 2.84 ± 2.72. Slightly more than half of the patients (51.4%) had a TB score ≤2, whereas 48.6% had a score >2. Based on the composite reference standard, tuberculosis was diagnosed in 27.1% of patients, while 72.9% were classified as non-TB cases. Anti-tubercular therapy was initiated in 28.6% of participants.

Table II: Tuberculosis Score Distribution and Final Diagnosis (n = 70)

Variable	Category	n (%)
TB Score Category	≤2	36 (51.4%)
	>2	34 (48.6%)
Final TB Diagnosis	Tuberculosis	19 (27.1%)
	Non-TB	51 (72.9%)
Anti-Tubercular Therapy Initiated	Yes	20 (28.6%)
	No	50 (71.4%)

Mean TB Score: **2.84 ± 2.72**

Chest radiography was normal in 60.0% of patients, while 40.0% showed abnormal findings. Sputum AFB microscopy was negative in 94.3% and positive in 5.7% of cases. Xpert MTB/RIF detected Mycobacterium tuberculosis in 7.1% of patients, whereas 92.9% tested negative.

Table III: Radiological and Microbiological Findings (n = 70)

Investigation	Category	n (%)
Chest X-ray	Normal	42 (60.0%)
	Abnormal	28 (40.0%)
Sputum AFB Microscopy	Negative	66 (94.3%)
	Positive	4 (5.7%)
Xpert MTB/RIF	MTB Detected	5 (7.1%)
	Not Detected	65 (92.9%)

The TB score (>2) demonstrated 100.0% sensitivity and 100.0% negative predictive value, indicating excellent rule-out performance. However, specificity was moderate at 55.4%, with a positive predictive value of 14.7%. In comparison, sputum AFB microscopy showed lower sensitivity (60.0%) but higher specificity (98.5%) and a positive predictive value of 75.0%.

Table IV: Diagnostic Performance of TB Score and Sputum AFB

Parameter	TB Score (>2)	Sputum AFB
Sensitivity	100.0%	60.0%
Specificity	55.4%	98.5%
Positive Predictive Value	14.7%	75.0%
Negative Predictive Value	100.0%	97.0%

Patients with TB score ≤2 had a higher mean CD4 count (403.78 ± 267.81 cells/mm³) compared to those with TB score >2 (287.59 ± 245.38 cells/mm³), although this difference did not reach statistical significance (p = 0.063). A statistically significant negative correlation was observed between TB score and CD4 count (r = −0.307, p = 0.010), indicating that higher TB scores were associated with lower CD4 levels.

Table V: Association Between TB Score and CD4 Count

TB Score Category	Mean CD4 ± SD	p-value
≤2	403.78 ± 267.81	0.063
>2	287.59 ± 245.38	

Pearson Correlation (TB Score vs CD4 Count): r = −0.307, p = 0.010

DISCUSSION

This study demonstrated that the clinical TB scoring system achieved perfect sensitivity and negative predictive value, making it highly effective as a rule-out screening tool in HIV-infected patients. Importantly, over half of the cohort could be safely categorized as low risk (score ≤2) without missing any TB cases. The observed TB prevalence (27.1%) reflects the tertiary-care hospital setting. Conventional sputum microscopy and Xpert MTB/RIF detected substantially fewer cases than the final TB diagnosis, highlighting the limitations of microbiological methods in HIV-associated TB. The moderate specificity of 55.4% represents an acceptable trade-off for a screening tool prioritizing sensitivity. The negative correlation between TB score and CD4 count supports the biological plausibility of the scoring system, as advanced immunosuppression is associated with more severe clinical manifestations.

These findings align with previous studies evaluating the Bandim TBscore and other clinical algorithms, reinforcing the potential role of structured clinical assessment in improving TB case-finding among PLHIV [11-13]. The observed TB prevalence of 27.1% reflects the tertiary care setting where patients often present with advanced disease or symptoms suggestive of tuberculosis. Notably, conventional microbiological methods identified far fewer cases than the final composite diagnosis. Sputum AFB microscopy detected only 5.7% of cases, and Xpert MTB/RIF identified 7.1% [14]. These findings highlight the well-recognized limitation of microbiological tests in HIV-associated TB, where low bacillary load and atypical presentations reduce diagnostic yield. The relatively high proportion of normal chest radiographs (60.0%) further emphasizes the diagnostic challenge in this population [15].

Although the TB score demonstrated moderate specificity (55.4%), this trade-off is acceptable in screening tools designed to prioritize sensitivity. In high-risk populations such as people living with HIV, missing active TB can have severe clinical consequences. Therefore, a high-sensitivity tool is preferable, even at the expense of increased confirmatory testing among false positives [16].

The significant negative correlation between TB score and CD4 count ($r = -0.307$, $p = 0.010$) supports the biological plausibility of the scoring system. Patients with higher TB scores tended to have lower CD4 counts, indicating more advanced immunosuppression and higher risk of active tuberculosis [17]. Although the difference in mean CD4 between TB score categories did not reach statistical significance ($p = 0.063$), the overall correlation suggests that clinical severity captured by the scoring system is related to immune status [18-20]. This study has several limitations that should be considered while interpreting the findings. First, the relatively small sample size ($n = 70$) and single-center design may limit the generalizability of the results to broader HIV populations. Second, the use of a composite reference standard, although practical in clinical settings, may introduce classification bias compared with culture-based confirmation. Third, sputum samples were not available from all patients, which may have affected microbiological yield. Additionally, the cross-sectional design does not allow assessment of longitudinal outcomes or predictive performance over time. Finally, the study was conducted in a tertiary care hospital, where TB prevalence is likely higher than in community settings, potentially influencing diagnostic performance measures.

CONCLUSION

The clinical TB scoring system demonstrated excellent diagnostic performance for ruling out tuberculosis among HIV-infected patients, with 100% sensitivity and negative predictive value. Its simplicity, feasibility, and strong screening capability support its integration into routine HIV care, particularly in resource-limited settings to optimize diagnostic pathways and facilitate safe initiation of tuberculosis preventive therapy.

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