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Computed Tomographic Findings of the Chest in Human Immunodeficiency Virus-Positive Patients Presenting With Respiratory Illness: A Cross-Sectional Study

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Abstract

Context: Human immunodeficiency virus (HIV) infection predisposes patients to a wide range of pulmonary opportunistic infections and malignancies. Computed tomography (CT) is considerably more sensitive than chest radiography in detecting early pulmonary abnormalities in this population.

Aims: To study the computed tomographic findings of the chest in HIV-positive patients presenting with respiratory illness and to correlate these findings with the final diagnosis.

Settings and Design: A hospital-based, prospective, observational study conducted in the Department of Radiodiagnosis of a tertiary care teaching hospital over a period of two years.

Methods and Material: Fifty-one symptomatic HIV-positive patients referred for CT chest were evaluated. Clinical and demographic details were recorded, and CT findings on high-resolution CT (HRCT), contrast-enhanced CT (CECT) or CT pulmonary angiography (CTPA) were documented and correlated with the final clinical diagnosis.

Statistical analysis used: Descriptive statistics (frequencies and percentages) were used to summarise clinical and radiological findings.

Results: The mean age was 46.9 years, with a male predominance (60.8%). Mediastinal lymphadenopathy (90.2%) was the most common CT finding, followed by fibrosis/bronchiectasis (64.7%), ground-glass opacity (60.8%), pleural effusion (60.8%) and consolidation (58.8%). Bilateral parenchymal involvement was seen in 80.4% of patients. An active infective etiology accounted for 74.5% of cases, with pulmonary tuberculosis the commonest final diagnosis (35.3%), followed by bacterial pneumonia (19.6%), Pneumocystis jirovecii pneumonia (11.8%) and fungal infection (7.8%).

Conclusions: CT chest, particularly HRCT, demonstrates a wide spectrum of pulmonary abnormalities in HIV-positive patients and is valuable for early detection, characterisation and differentiation of opportunistic pulmonary disease. Mediastinal lymphadenopathy and pulmonary tuberculosis were the predominant findings in this cohort.

Keywords: Computed tomography; HIV; lymphadenopathy; pulmonary tuberculosis; respiratory illness

Key Messages: Mediastinal lymphadenopathy and pulmonary tuberculosis predominate among CT chest findings in HIV-positive patients with respiratory illness, and HRCT remains the imaging modality of choice for early detection and characterisation of opportunistic pulmonary disease in this population.

Introduction

Human immunodeficiency virus (HIV) infection causes progressive depletion of CD4 T-lymphocytes, predisposing patients to a wide spectrum of pulmonary opportunistic infections and malignancies.[1] Pulmonary tuberculosis remains the most frequent opportunistic infection, particularly in tuberculosis-endemic countries such as India.[2] Chest radiography has limited sensitivity for early or subtle parenchymal abnormalities, whereas computed tomography, particularly high-resolution computed tomography (HRCT), provides superior characterisation of disease patterns.[3] This study was undertaken to evaluate the computed tomographic findings of the chest in HIV-positive patients presenting with respiratory illness and to correlate these findings with the final diagnosis.

Subjects and Methods

This hospital-based, prospective, observational study was conducted in the Department of Radiodiagnosis of a tertiary care teaching hospital over a period of two years, from January 2024 to December 2025, after approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants.

Fifty-one HIV-positive patients presenting with respiratory symptoms and referred to the Department of Radiodiagnosis for CT evaluation of the chest were included. Both inpatients and outpatients, irrespective of whether they were receiving antiretroviral therapy (ART), were eligible. All symptomatic HIV-positive patients with respiratory illness were included; patients unwilling to provide consent were excluded.

Relevant clinical history (age, sex, presenting symptoms), clinical examination findings and available laboratory investigations, including CD4 cell count, were recorded for each patient. Radiological variables assessed on CT included consolidation, ground-glass opacity, pulmonary nodules, cavitation, tree-in-bud pattern, mediastinal and hilar lymphadenopathy, and pleural effusion. Lung parenchymal involvement was classified as bilateral, unilateral or absent.

All CT scans were performed on 128-slice or 160-slice multidetector CT scanners, with patients positioned supine and arms raised above the head. Scanning was performed craniocaudally during a single breath-hold in full inspiration, from the lung apices to the costophrenic angles, with free-breathing acquisition in patients unable to hold their breath. HRCT was the primary imaging modality, performed using thin-section images of 0.625–1.25 mm slice thickness with a high-frequency reconstruction kernel; contrast-enhanced CT (CECT) of the thorax and CT pulmonary angiography (CTPA) were additionally performed where clinically indicated, using non-ionic iodinated contrast medium administered intravenously.

Operational definitions used to standardise interpretation of CT findings were as follows: consolidation, an area of increased pulmonary attenuation obscuring vessel and airway margins; ground-glass opacity, a hazy increase in lung attenuation without obscuration of underlying vessels or bronchi; pulmonary nodules, rounded or irregular opacities measuring less than three centimetres in diameter; cavitation, a gas-filled space within a consolidation, mass or nodule; tree-in-bud pattern, centrilobular nodules with branching linear opacities representing endobronchial spread of infection; and lymphadenopathy, mediastinal or hilar lymph nodes measuring more than 10 mm in short-axis diameter.

The final diagnosis in each patient was established by integrating CT findings with the clinical presentation and available laboratory investigations. Descriptive statistics (frequencies and percentages) were used to summarise clinical and radiological findings, and results are presented as tables.

Results

Fifty-one HIV-positive patients with respiratory illness were evaluated. The mean age was 46.9 years; the majority of patients (49.0%) were in the 30–50-year age group, followed by those older than 50 years (41.2%). A male predominance was noted, with 31 patients (60.8%) being male and 20 (39.2%) female. Fever was the most common presenting symptom (33.3%), followed by breathlessness (31.4%) and cough (29.4%); chest pain, abdominal pain and weight loss were less frequent. Thirty patients (58.8%) were receiving antiretroviral therapy at presentation, while 21 (41.2%) were not. CD4 count was documented in only four patients (7.8%); it was unavailable in the remaining 47 (92.2%), limiting correlation between CT findings and immune status in this cohort (Table 1).

Table 1: Demographic and Clinical Profile (n = 51)	**Number**	**Percentage**
Age group: <30 years	5	9.8%
Age group: 30–50 years	25	49.0%
Age group: >50 years	21	41.2%
Sex: Male	31	60.8%
Sex: Female	20	39.2%
Fever	17	33.3%
Cough	15	29.4%
Breathlessness	16	31.4%
Chest pain	4	7.8%
Abdominal pain	3	5.9%
Weight loss	2	3.9%
On antiretroviral therapy	30	58.8%
Not on antiretroviral therapy	21	41.2%

HRCT was the predominant imaging study performed, in 38 patients (74.5%), followed by CECT in 11 (21.5%) and CTPA in two (3.9%) (Table 2).

Table 2: Type of CT Examination Performed (n = 51)	**Number**	**Percentage**
HRCT	38	74.5%
CECT	11	21.5%

CTPA	2	3.9%

Mediastinal/hilar lymphadenopathy was the single most common CT finding, present in 46 patients (90.2%), followed by fibrosis/bronchiectasis (64.7%), ground-glass opacity (60.8%), pleural effusion (60.8%) and consolidation (58.8%). Tree-in-bud pattern and pulmonary nodules were also frequent, while cavitation was the least common finding. As individual patients commonly demonstrated more than one CT feature, the percentages in Table 3 do not sum to 100%.

Table 3: CT Chest Findings (n = 51)	**Number**	**Percentage**
Mediastinal/hilar lymphadenopathy	46	90.2%
Fibrosis/bronchiectasis	33	64.7%
Ground-glass opacity	31	60.8%
Pleural effusion	31	60.8%
Consolidation	30	58.8%
Tree-in-bud pattern	24	47.1%
Pulmonary nodules	21	41.2%
Emphysema	13	25.5%
Cavitation	4	7.8%

Bilateral lung parenchymal involvement was the predominant pattern, seen in 41 patients (80.4%); unilateral involvement was noted in six patients (right-sided in five, left-sided in one), and four patients (7.8%) showed no significant parenchymal finding. An active infective etiology was identified in 38 patients (74.5%), of which pulmonary tuberculosis was the commonest (35.3%), followed by bacterial pneumonia (19.6%), Pneumocystis jirovecii pneumonia (11.8%) and fungal infection (7.8%). Old infective sequelae (fibrosis, bronchiectasis or fibrocalcific change) accounted for seven cases (13.7%), no significant CT abnormality was seen in four cases (7.8%), and a neoplastic etiology was identified in two cases (3.9%) (Table 4).

Table 4: Pattern of Lung Involvement and Final Diagnosis (n = 51)	**Number**	**Percentage**
Bilateral parenchymal involvement	41	80.4%
Unilateral involvement (right)	5	9.8%
Unilateral involvement (left)	1	2.0%
No significant parenchymal finding	4	7.8%
Active infective etiology – total	38	74.5%
Pulmonary tuberculosis	18	35.3%

Bacterial pneumonia	10	19.6%
Pneumocystis jirovecii pneumonia	6	11.8%
Fungal infection	4	7.8%
Old infective sequelae	7	13.7%
No significant abnormality (normal)	4	7.8%
Neoplasm	2	3.9%

On clinical follow-up, 27 patients (52.9%) showed improvement and 24 (47.1%) remained stable, with no mortality recorded in this cohort (Table 5).

Table 5: Clinical Outcome (n = 51)	**Number**	**Percentage**
Improved	27	52.9%
Stable	24	47.1%
Death	0	0%

Representative case illustrations from the study cohort are shown in Figures 1–7 (uploaded separately as image files; legends provided at the end of this document).

Discussion

The present study evaluated CT chest findings in 51 HIV-positive patients and demonstrated a wide spectrum of pulmonary abnormalities, predominantly of infective etiology, consistent with previous reports.[4,5]

The majority of patients in the present study belonged to the 30–50-year age group (49.0%), with a mean age of 46.9 years, indicating that pulmonary manifestations of HIV infection were most frequent in the economically productive age group. A definite male predominance was observed (60.8%). Similar age and sex distributions have been reported by Ujjaliya and Dwivedi[6] and by Jadhav and Sai,[7] and are consistent with the epidemiological pattern of HIV infection in India.

Mediastinal lymphadenopathy was the most common CT finding in the present study (90.2%), occurring across multiple diagnostic categories including tuberculosis, bacterial pneumonia, fungal infection and neoplasm. While lacking diagnostic specificity in isolation, its morphology, distribution and enhancement characteristics — for example, necrotic nodes with peripheral rim enhancement in tuberculosis — helped to narrow the differential diagnosis when considered alongside other CT features. Similar emphasis on mediastinal lymph node enlargement as a consistent feature of HIV-associated thoracic disease has been reported by Hartman et al.[8] and Chou et al.,[9] who also evaluated thoracic complications of HIV using CT.

Ground-glass opacity was identified in 60.8% of patients in the present study. Diffuse bilateral ground-glass opacity, particularly in a perihilar distribution, is a recognised feature of Pneumocystis jirovecii pneumonia,[10] and our findings were in keeping with this pattern in the relevant subgroup. It is also notable that increased lung attenuation on CT in HIV-positive patients may, in a subset of cases, reflect subclinical pulmonary inflammation rather than an overt opportunistic infection, as described by D'Ambrosio et al.[11]

and Gingo et al.,[12] who demonstrated subclinical CT and pulmonary function abnormalities in HIV-positive patients independent of overt respiratory symptoms.

Consolidation (58.8%), pulmonary nodules (41.2%) and tree-in-bud pattern (47.1%) were also frequently observed, the latter two patterns being characteristic of endobronchial spread of infection, particularly tuberculosis, as described by Gruden et al.[13] Cavitation was comparatively uncommon (7.8%), which may reflect blunted inflammatory response in the setting of advanced immunosuppression; nonetheless, when present, it strongly suggested active tuberculous disease.

Pleural effusion was noted in 60.8% of patients and occurred across several diagnostic categories. Bilateral parenchymal involvement (80.4%) was considerably more common than unilateral disease, consistent with the diffuse pattern of opportunistic pulmonary infection typically seen in immunocompromised patients.

Pulmonary tuberculosis was the commonest final diagnosis in this cohort (35.3%), reflecting the high tuberculosis burden in India and the well-recognised increase in both primary infection and reactivation risk conferred by HIV-related immunosuppression.[14] Bacterial pneumonia (19.6%) and Pneumocystis jirovecii pneumonia (11.8%) were the next most frequent diagnoses, while fungal infection accounted for 7.8% of cases, with CT features including nodules, cavitation and a surrounding ground-glass halo, as described by Bhandari Grover et al.[15]

Old infective sequelae — fibrosis, bronchiectasis and fibrocalcific change, predominantly in the upper lobes — were identified in 13.7% of patients, representing residual structural lung damage from prior infection, a pattern also described by Ferrand et al.,[16] and several of these patients additionally showed superimposed active changes, illustrating active-on-chronic disease. Persistence of pulmonary complications despite antiretroviral therapy, observed in a substantial proportion of our cohort, has similarly been reported in patients with delayed treatment initiation or advanced disease at diagnosis.

Neoplastic etiology, although the least common diagnostic category in this study (3.9%), is an important consideration in HIV-positive patients, particularly those with risk factors such as smoking, as highlighted by Sigel et al.[17] and Javid et al.,[18] who emphasised the role of CT in early detection of malignancy and in distinguishing it from HIV-associated mimics.

Overall, these findings reaffirm that CT — and HRCT in particular — is the imaging modality of choice for evaluating pulmonary disease in HIV-positive patients, given its superior sensitivity over chest radiography for detecting and characterising parenchymal, mediastinal and pleural abnormalities.[19] A recurring observation in this study, as in others, was that individual CT patterns frequently overlapped across different etiologies; CT findings are therefore best used to narrow rather than to establish a definitive diagnosis, in conjunction with clinical and laboratory correlation.

Limitations

CD4 count was available in only four of 51 patients, which limited correlation between the degree of immunosuppression and specific CT patterns. This was a single-centre study with a relatively modest sample size, and microbiological confirmation was not uniformly available for all final diagnoses.

Conclusion

CT chest, particularly HRCT, demonstrates a wide spectrum of pulmonary abnormalities in HIV-positive patients presenting with respiratory illness and is valuable for early detection, characterisation and differentiation of opportunistic pulmonary disease. Mediastinal lymphadenopathy was the most common

CT finding, and pulmonary tuberculosis was the predominant final diagnosis in this cohort, underscoring the continued importance of CT chest in the comprehensive evaluation and management of HIV-associated pulmonary disease.

References

1. Allen CM, Al-Jahdali HH, Irion KL, Al Ghanem S, Gouda A, Khan AN. Imaging lung manifestations of HIV/AIDS. Ann Thorac Med. 2010;5(4):201–216.
2. National AIDS Control Organisation (NACO). India HIV Estimations 2023: Technical Report. New Delhi: Ministry of Health and Family Welfare, Government of India; 2023.
3. Ahuja J, Kanne JP. Thoracic infections in immunocompromised patients. Radiol Clin North Am. 2014;52(1):121–136.
4. Rani S, Kumar R. High-resolution computed tomography lung spectrum in symptomatic adult HIV-positive patients. Int J Sci Res. 2024;13(7):1–5.
5. Gozdas HT, Ozer H. Chest computed tomography findings of people living with HIV with opportunistic pneumonia. Radiol Infect Dis. 2024;11(1):1–8.
6. Ujjaliya MK, Dwivedi S. HRCT lung spectrum in HIV patients with CD4 correlation. Int J Sci Stud. 2019;6(10):5–12.
7. Jadhav S, Sai KB. Role of HRCT chest in early diagnosis of pulmonary disease in symptomatic HIV patients. Eur J Mol Clin Med. 2021;8(3):1–6.
8. Hartman TE, Primack SL, Lee KS, Müller NL. CT of pulmonary complications in AIDS. AJR Am J Roentgenol. 2000;174(3):735–739.
9. Chou SHS, Crothers K, Stern EJ, Godwin JD, Pipavath SNJ. Thoracic diseases in HIV. Radiographics. 2014;34(4):895–911.
10. Kanne JP, Godwin JD, Franquet T, Müller NL, Stern EJ. Viral pneumonia: CT findings. Radiology. 2002;223(3):871–878.
11. D'Ambrosio C, Faisca-Lima C, Ronald LA, Crothers K. Increased CT lung density in HIV patients. AIDS. 2017;31(2):227–233.
12. Gingo MR, Balasubramani GK, Kingsley L, Román J, Huang L, Greenblatt RM, et al. Pulmonary function in HIV. Am J Respir Crit Care Med. 2010;182(6):790–796.
13. Gruden JF, Webb WR, Naidich DP, McGuinness G. Multinodular lung disease: CT patterns. Radiology. 2002;222(3):815–822.
14. Palaniswamy LD, Pandiyan MSR, Murugesan P. Clinical, laboratory and radiological spectrum of tuberculosis in HIV patients. Evid Based Med Healthc. 2021;8(16):1025–1029.
15. Bhandari Grover S, Grover H, Antil N, Patra S, Sen M, Nair D. Imaging approach to pulmonary infections in immunocompromised patients. Indian J Radiol Imaging. 2022;32(1):81–112.
16. Ferrand RA, Desai SR, Hopkins C, Elston CM, Copley SJ, Nathoo K, et al. Chronic lung disease in HIV. Clin Infect Dis. 2012;55(1):172–180.
17. Sigel K, Wisnivesky J, Gordon K, Dubrow R, Justice A, Brown ST, et al. Lung cancer risk in HIV. AIDS. 2012;26(8):1017–1025.
18. Javid S, Menias CO, Karbasian N, Shaaban A, Shah K, Osman A, et al. HIV-related malignancies and mimics. Radiographics. 2018;38(7):2051–2068.
19. Kunihiro Y, Tanaka N, Kawano R, Yujiri T, Kubo M, Yamamoto K, et al. Differential diagnosis of pulmonary infections using HRCT. Eur J Radiol. 2019;113:148–158.

20. Crothers K, Huang L, Goulet JL, Greenblatt RM, Justice AC, Roediger MP, et al. HIV infection and risk for incident pulmonary diseases in the combination antiretroviral therapy era. Am J Respir Crit Care Med. 2011;183(3):388–395.

Figure Legends

1. **Figure 1:** Axial CT chest (lung window) in a 41-year-old HIV-positive woman with acute breathlessness, showing diffuse ground-glass opacities with septal thickening and pneumomediastinum, consistent with Pneumocystis jirovecii pneumonia.
2. **Figure 2:** Axial HRCT chest in a 19-year-old HIV-positive man with miliary tuberculosis, showing diffuse randomly distributed micronodules with bilateral pneumothorax, an acute complication occurring in a background of disseminated disease.
3. **Figure 3:** Axial HRCT chest in a 53-year-old HIV-positive man with prior tuberculosis, showing centrilobular tree-in-bud nodules with fibrocalcific and bronchiectatic change, indicating active-on-chronic pulmonary infection on a background of post-tubercular lung disease.
4. **Figure 4:** Axial HRCT chest in a 45-year-old HIV-positive man with chronic cough, showing multiple randomly distributed cavitating nodules with surrounding ground-glass opacities, suggestive of opportunistic pulmonary fungal infection.
5. **Figure 5:** Axial CECT chest in a 67-year-old HIV-positive man with chronic smoking history, showing a spiculated right upper lobe mass with bronchial cut-off and mediastinal lymphadenopathy, suggestive of primary lung malignancy.
6. **Figure 6:** Axial HRCT chest in a 36-year-old HIV-positive man, showing lobar and segmental consolidation with air bronchograms and ground-glass opacities, with mild right pleural effusion, consistent with bacterial pneumonia.
7. **Figure 7:** Axial HRCT chest in a 37-year-old HIV-positive man with chronic smoking history, showing a fibrocavitary lesion in the left upper lobe containing a mobile intracavitary soft-tissue fungal ball, consistent with aspergilloma.