ORIGINAL ARTICLE

Prevalence of Cardiovascular Diseases in Young Human Immunodeficiency Virus-positive Patients in Western Uttar Pradesh

Sandhya Gautam[1*], Shivang Dhaka[2], Chhaya Mittal[3], Gajraj Singh[4], Snehlata Verma[5], Dheeraj Soni[6]

Received: 04 February 2025; *Accepted:* 05 March 2025

Abstract

Introduction: Human immunodeficiency virus-acquired immunodeficiency syndrome (HIV-AIDS) is an important public health problem with almost 39.9 million people living with HIV (PLHIV) all over the world and 1.3 million new cases being detected every year according to a report by the World Health Organization. Due to an increase in the treatment landscape for HIV-positive patients, a revolutionary transformation has occurred in the life expectancy of these people. HIV is a chronic viral infection that can cause suppression of the body's immune response, leading to inflammatory changes and elevation in markers of inflammation such as C-reactive protein (CRP), interleukin-6 (IL-6). These elevated inflammatory markers are associated with increased risk of atherosclerosis as well as cardiovascular diseases.

Methodology: This was a cross-sectional observational study, which was conducted at LLRM Medical College. Sample size calculation was done, and considering inclusion and exclusion criteria, 100 patients were included for the study, and all the parameters (clinical, biochemical, radiological) were assessed.

Results: Out of 100 patients, almost half (53%) were in the 18–30 years age-group, and 47% were in the 31–40 years age-group. The male-to-female ratio was almost equal (45:55). The maximum patients in our study were graduates (42%), while only 5% were illiterate. The most common occupation in our study was semiskilled persons (38%). The most common electrocardiogram (ECG) finding was sinus tachycardia (27%), the second most common finding was low-voltage complexes, which were present in 10% of patients; diffuse ST-T changes were the third commonest finding (4%), while 54% of patients did not show any ECG abnormality. On echocardiography of the patients, 70% did not show any abnormality, while 12% had pericardial effusion, 7% had dilated cardiomyopathy (DCMP), 5% had concentric left ventricular hypertrophy (LVH) with left ventricular diastolic dysfunction (LVDD), 3% showed pulmonary hypertension, and 3% had grade 1 diastolic dysfunction.

Conclusion: Cardiac abnormality was found in 30% of patients, which must be considered a risk factor for HIV patients. The most common cardiac abnormality was pericardial effusion, the cause of which should be investigated further for proper management of the patients. These results emphasize the importance of regular cardiovascular monitoring in HIV-positive patients.

Journal of The Association of Physicians of India (2025): 10.59556/japi.73.1119

Introduction

Human immunodeficiency virus (HIV) has become a manageable condition due to antiretroviral therapy (ART). In HIV-positive patients, cardiovascular disease (CVD) is prevalent, with 78% expected to face CVD by the end of 2030.[1,2] HIV-positive individuals face higher CVD risks due to dyslipidemia, chronic inflammation, and ART-related side effects. Early signs like increased intima-media thickness (IMT) indicate atherosclerosis. The risk of cardiovascular disease is elevated due to four major factors: chronic inflammation, immune activation, side effects of medicines given for treatment,[3] and the chronic nature of HIV infection.[4,5] HIV infection as well as certain ART regimens both cause lipid derangement, which includes elevated levels of LDL, cholesterol, and triglycerides. These lipid abnormalities act as important contributory factors leading to the development of atherosclerosis, which is one of the most important risk factors for coronary artery disease.[6] Elevated markers of inflammation, such as C-reactive protein (CRP) and interleukin-6 (IL-6), are linked to accelerated atherosclerosis and increased cardiovascular risk.[3] HIV-positive individuals often exhibit impaired endothelial function, which is associated with elevated inflammatory markers and reduced availability of nitric oxide, a molecule essential for maintaining vascular health.[3] Other risk factors, like obesity and metabolic syndrome, are also associated with risk of cardiovascular disease. As the HIV-positive population ages, risk factors such as hypertension, diabetes, and age-related arterial changes become more prevalent. Therefore, we selected young HIV patients to rule out the effect of age on CVD. Research emphasizes the need for early CVD screening in HIV-positive individuals and improved ART with fewer cardiovascular side effects. India's HIV burden varies regionally, influenced by socioeconomic factors, migration, and healthcare access. Effective interventions are ongoing, but challenges like stigma and healthcare gaps remain. As ART extends lives, CVD has become a major health concern for HIV-positive individuals, requiring proactive management. Regional studies, such as in western Uttar Pradesh, are important to assess the burden of CVD in HIV patients to improve further quality of life.

Aims and Objectives

- To see the prevalence of cardiovascular disease in young HIV-positive patients on ART.
- To study different cardiac abnormalities in HIV-positive patients.

The study was a cross-sectional observational, single-center study conducted among patients attending the OPD and IPD of the Medicine Department and the ART Plus Centre of LLRM Medical College, Meerut during 2023. The patient population comprised young HIV-positive individuals who met the inclusion and exclusion criteria. Taking the prevalence of cardiovascular disease in young HIV patients as 50%, sample size was calculated

[1]Professor; [2]Junior Resident, Department of Medicine, LLRM Medical College; [3]Professor, Department of Community Medicine, SMMH Medical College, Meerut; [4]Professor, Department of Orthopedics, Venkateshwara Institute of Medical Sciences, Amroha; [5]Associate Professor, Department of Medicine; [6]Assistant Professor, Department of Cardiology, LLRM Medical College, Meerut, Uttar Pradesh, India; *Corresponding Author

How to cite this article: Gautam S, Dhaka S, Mittal C, *et al.* Prevalence of Cardiovascular Diseases in Young Human Immunodeficiency Virus-positive Patients in Western Uttar Pradesh. J Assoc Physicians India 2025;73(10):e9–e12.

by 4pq/d^2, which came out to 100. Ethical clearance was taken from the Institutional Ethics Committee with ref no /SC-1/2024/5664.

Eligibility Criteria

Inclusion Criteria

- Young HIV-positive patients.
- Age 18–40 years.

Exclusion Criteria

- Patient age below 18 years and above 40 years.
- Patient not giving consent.
- Severely ill HIV patients.
- Patients with type 2 diabetes mellitus, rheumatic heart disease, congenital heart disease, chronic respiratory illness, hyperthyroidism, hypothyroidism, COPD, bronchial asthma, BMI >30.

Considering inclusion and exclusion criteria, 100 HIV-positive patients were included, and all the parameters (clinical, biomedical, radiological) were assessed. Written informed consent was taken from patients after being fully briefed about the study's purpose and methodology. All participants provided detailed history using a predesigned, pretested proforma. The examination comprised all parameters of general physical examination such as PR (pulse rate), oxygen saturation, BP, RR, temperature, JVP, and signs of pallor, icterus, cyanosis, clubbing, edema, and lymphadenopathy. Anthropometric measurements of all study subjects were included such as height (in meters), weight (in kilograms), body mass index (BMI), waist circumference, hip circumference, and the waist-hip ratio. A systemic examination to assess different systems like the cardiovascular system, respiratory system, abdomen, and central nervous system was done. All relevant investigations were conducted to evaluate the patient's health status including Hb, TLC, DLC, platelet count, RBC count, RBC indices (MCV, MCH, MCHC), reticulocyte count, HBsAg, and anti-HCV. Other important tests included fasting lipid profile, liver function tests, kidney function tests, HbA1c, thyroid profile (FT3, serum TSH), and CD4 count. Imaging studies such as chest X-ray and echocardiography were performed, along with ECG. 2D ECHO with color flow Doppler assessment in M-mode was done for all patients. As per the conventions of the American Society of Echocardiography, the left atrial dimensions, left ventricular (LV) end systolic and end diastolic dimensions, and right ventricular (RV) end diastolic dimensions were obtained. Left ventricular volumes and ejection fraction (EF) were calculated. For statistical analysis, all collected data were entered in Microsoft Excel sheet and then analyzed by using SPSS software version 22. Appropriate descriptive and Chi-squared tests were used to analyze the data. Statistical significance was defined as $p < 0.05$.

Observation and Results

Table 1 provides a demographic profile of HIV-positive patients. The majority of patients were between the age-group 18 and 30 years (53%), with the remaining 47% between the age-group of 31 and 40 years. Gender distribution shows almost equal numbers of both male and female, with 45% male and 55% female. Educationally, 42% of the patients are graduates, 23% have completed up to the 12th grade, 17% up to the 10th grade, 13% up to the 8th grade, and 5% of study participants were either educated below 8th grade level or illiterate. In terms of occupation, 5% of patients were professionally qualified, 28% were in skilled jobs, 38% were in semiskilled jobs, 21% were in unskilled jobs, and 8% were either unemployed or students.

Table 2 summarizes the electrocardiographic (ECG) findings among HIV-positive patients. Sinus tachycardia is the most common finding observed in 27% of patients, while 10% of patients show low-voltage complexes. Diffuse ST-T changes are present in 4% of study participants, and 3% of patients show poor R wave progression. P pulmonale is found in 2% of the patients. Notably, 54% of the patients show nonspecific electrocardiographic abnormalities.

Table 3 outlines the chest X-ray findings among HIV-positive patients. Cardiomegaly is present in 7% of the patients, pulmonary edema in 3%, prominent vascular markings in 2%, and right upper lobe opacity in another 2%. Most patients, 86%, show no specific chest radiographic abnormalities.

Figure 1 shows the analysis of cardiac findings on 2D-ECHO in relation to the age of HIV patients. It reveals significant differences between the two age-groups. Among patients aged 18–30 years, a substantial majority (45 out of 53, or 84.9%) exhibited normal echocardiographic

Table 2: ECG findings in HIV patients

Serial	*Electrocardiographic (ECG) findings*	*No. of patients (percentage)*
1	Sinus tachycardia	27 (27%)
2	Low voltage complexes	10 (10%)
3	Diffuse ST-T changes	4 (4%)
4	Poor R wave progression	3 (3%)
5	P pulmonale	2 (2%)
6	No specific electrocardiographic findings	54 (54%)
	Total	100

Table 1: Sociodemographic indicators

	No. of patients (percentage)
Age (years)	
18–30 years	53 (53%)
31–40years	47 (47%)
Total	100
Gender	
Male	45 (45%)
Female	55 (55%)
Total	100
Educational status	
Graduate	42 (42%)
12th	23 (23%)
10th	17 (17%)
8th	13 (13%)
Below 8th or illiterate	5 (5%)
Total	100
Occupation	No. of HIV patients (percentage)
Professional	5 (5%)
Skilled	28 (28%)
Semiskilled	38 (38%)
Unskilled	21 (21%)
Unemployed and students	8 (8%)
Total	100

results, while only 8 patients (15.1%) showed abnormal findings. In contrast, the 31–40-year age-group demonstrated a notably different pattern, with 25 out of 47 patients (53.2%) having normal ECHO results and 22 patients (46.8%) showing abnormalities. The prevalence of abnormal ECHO findings between the two age-groups is statistically significant, with a *p*-value of 0.000552, indicating a strong correlation between advancing age and the likelihood of abnormal cardiac findings among HIV patients.

Figure 2 presents the echocardiographic findings among patients. Pericardial effusion is the most common finding, observed in 12% of patients, while 7% have dilated cardiomyopathy. Concentric left ventricular hypertrophy (LVH) with left ventricular diastolic dysfunction (LVDD) is seen in 5% of patients, and 3% each have pulmonary hypertension and grade 1 diastolic dysfunction. Notably, 70% of the patients did not show any specific echocardiographic abnormalities.

Table 4 analyzes the relationship between CD4 count and echocardiographic (ECHO) findings. Among the patients with CD4 count <350, approximately 46 (70.77%) had normal echocardiographic findings and 19 (29.23%) had abnormal findings. For patients with CD4 counts greater than 350, 24 (68.57%) had normal ECHO findings and 11 (31.43%) had abnormal findings. The total number of patients was 100, with 70 having normal and 30 having abnormal echocardiographic findings. The *p*-value of 0.8196 suggests no statistically significant correlation between CD4 count level and echocardiographic findings in our study.

Discussion

Early detection and management of cardiovascular risk factors in HIV-positive patients is of utmost importance to improve the cardiovascular health of young HIV-positive patients. Cardiovascular disease onset can have long-term implications on their overall health and lifespan. Hypertension, diabetes, and dyslipidemia, when compounded by HIV-specific factors like chronic inflammation, immune activation, and the side effects of ART, act as risk factors for cardiovascular disease. Moreover, young patients often face unique challenges related to adherence to ART and lifestyle modifications necessary to mitigate cardiovascular risk.

The present study conducted to see the prevalence of cardiovascular diseases and risk factors among young HIV-positive patients in Western UP. provides significant insights. Depending on the screening methods selected, population studied, and the definition of cardiac abnormality, prevalence of cardiac disease in HIV/AIDS varies. According to Kaul et al., it may range from 28 to 73%.[7]

The present study included 100 HIV patients who were between 18 and 40 years of age. Cardiac abnormality in our study was found in 30% of HIV-positive patients, which is slightly less in comparison with Chaudhary et al.,[8] in whose study 52% of HIV patients had echocardiographic abnormalities. On echocardiography, pericardial effusion was observed in 12% of the patients, which aligns with previous studies indicating an increased incidence of pericardial effusion in advanced stages of HIV. Supporting our observation, Heidenreich et al.[9] found that along with progression of HIV infection, there is an increase in the incidence of pericardial effusion. In their study, asymptomatic HIV-positive patients had 0% incidence of pericardial effusion, whereas patients with advanced AIDS had an increased incidence of pericardial effusion (11% per year). A study done by Chaudhary et al. (2017) also showed similar findings, with an 11% prevalence of pericardial effusion.[8]

In the present study, sinus tachycardia was the most commonly observed finding,

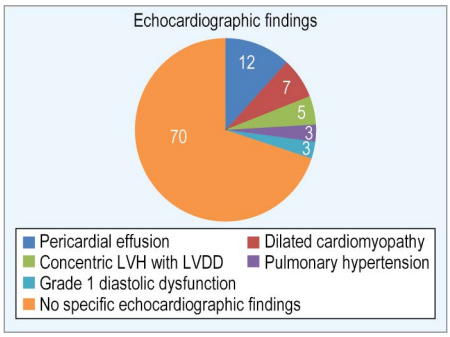

Fig. 2: Echocardiographic findings in HIV patients

Table 3: Chest radiographic findings in HIV patients

Serial	*Chest radiographic findings*	*Number of patients (percentage)*
1	Cardiomegaly	7 (7%)
2	Pulmonary edema	3 (3%)
3	Prominent vascular markings	2 (2%)
4	Right upper lobe opacity	2 (2%)
5	No specific chest radiographic findings	86 (86%)
Total		100

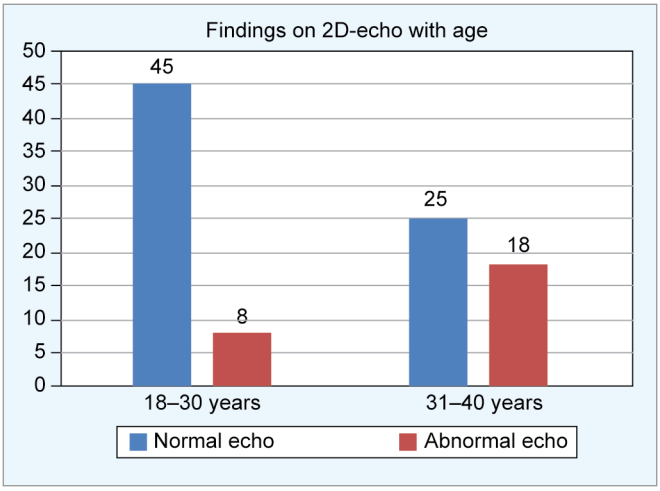

Fig. 1: 2D echocardiographic findings in various age-groups

Table 4: Correlation of CD4 counts with echocardiographic abnormality

CD4 count	*Normal ECHO*	*Abnormal ECHO*	*Row totals*	*p-value*
CD4 <350	46 (70.77%)	19 (29.23%)	65	0.8196
CD4 >350	24 (68.57%)	11 (31.43%)	35	
Column total	70	30	100	

occurring in almost 27% of the patients. This high prevalence of sinus tachycardia is consistent with the increased sympathetic activity and possible autonomic dysfunction seen in HIV-infected individuals. ECG abnormalities were found in 46% of patients. Fisher et al. observed in his study that 57% of asymptomatic HIV-infected patients have supraventricular and ventricular ectopic beats in ECG.[10] Also, the ECG findings of our study are in accordance with findings of Marwadi et al., who observed sinus tachycardia in 24% of cases.[11] The most common ECG abnormality was sinus tachycardia in the study by Chaudhary et al. (2017).[8] Low-voltage complexes were detected in 10% of the patients. This finding can be indicative of pericardial effusion or other conditions affecting the heart's electrical activity, such as myocardial fibrosis or infiltrative diseases. Dilated cardiomyopathy was another important finding, present in 7% of the patients in the present study. This condition can be a significant complication in HIV-positive individuals, potentially linked to both the virus itself and antiretroviral therapy. Other researchers like Moreno et al.[12] and Hakim et al.[13] found dilated cardiomyopathy in 6 and 5% of people living with HIV, respectively. Left ventricular diastolic dysfunction (LVDD) with concentric left ventricular hypertrophy (LVH) was found in 5% of the patients. This abnormality indicates structural changes in the heart that can lead to impaired cardiac function over time.

In our study, the chest X-ray findings of HIV patients reveal that the majority, 86%, show no specific radiographic abnormalities, indicating a generally normal chest radiograph in most cases. However, there are notable findings in the remaining 14% of patients. Cardiomegaly is observed in 7% of patients, suggesting potential heart enlargement, which could be indicative of underlying cardiovascular issues. Pulmonary edema is seen in 3% of patients, pointing to fluid accumulation in the lungs, possibly due to heart failure or other conditions. Prominent vascular markings and right upper lobe opacity are each found in 2% of patients, which may suggest vascular or localized lung pathology, respectively. This finding was supported by a similar study done by Akinbami et al., who found cardiomegaly present in 6.86% of patients.[14] While Reddy et al. observed that the most common abnormal chest X-ray finding was cardiomegaly (38.82%).[15] These findings highlight that while most HIV patients have normal chest X-rays, a small but significant proportion exhibit abnormalities that warrant further clinical evaluation and management.

The data suggest no significant association between CD4 count and cardiac abnormalities on 2D-ECHO in HIV-infected individuals (p-value = 0.819). The data show that among patients with CD4 count <350, 19 out of 65 (29.2%) had abnormal echocardiogram results, compared to 11 out of 35 (31.4%) with CD4 count >350. This finding is consistent with previous research that has shown that CD4 count is not a strong predictor of cardiac disease in HIV-infected individuals. Researchers such as Chaudhary et al. also demonstrated a similar finding that the prevalence of cardiovascular abnormalities does not show any significant association with CD4 count.[8] Contrary to this finding, Reddy et al. observed that HIV patients with low CD4 count are at higher risk of cardiac abnormalities.[15]

Summarizing the findings of the present study, there is a high need for regular monitoring of cardiovascular risk factors in young HIV-positive patients to reduce cardiac mortality and morbidity.

Limitations of the Study

- Cross-sectional design limits the ability to determine causality or track changes in cardiovascular health over time.
- Selection bias: Focus on western Uttar Pradesh may affect representativeness for HIV-positive patients from other regions or countries.
- Generalizability of findings: As study was done on younger patients, results may not apply to older HIV-positive patients or those at different stages of HIV progression.
- Variability in echocardiographic interpretation: Different practitioners may lead to inconsistent and unreliable findings, so observer variation may be present.

Recommendations for Further Study

- Longitudinal analysis: Track cardiovascular health over time in HIV-positive patients to understand progression and long-term outcomes.
- Multicenter research: Conduct studies across diverse geographic locations to obtain a comprehensive view of cardiovascular disease prevalence and determinants.
- Additional diagnostic tools: Utilize cardiac MRI, CT scans, and advanced echocardiographic techniques for detailed assessment of cardiovascular abnormalities.
- Investigate treatment and adherence: Collect data on antiretroviral therapy regimens and adherence rates to assess their impact on cardiovascular health.
- Genetic and viral load factors: Explore the influence of genetic predispositions and viral load levels on cardiovascular abnormalities.
- Future efforts aim to understand HIV's impact on CVD and develop tailored risk assessment tools.

These recommendations aim to enhance understanding of cardiovascular disease in young HIV-positive patients.

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