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Cardiac Abnormalities among Patients Receiving Antiretroviral Therapy at the University Clinics of Kinshasa, Democratic Republic of the Congo

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Abstract

Background: Comparative data on the cardiac impact of different antiretroviral therapy (ART) regimens in sub-Saharan Africa remain limited. The aim of this study was to determine which ART regimen is most associated with cardiac abnormalities during follow-up of patients at the University Clinics of Kinshasa. **Methods:** A historical cohort study was conducted at the University Clinics of Kinshasa among adult patients living with HIV who had been receiving ART for at least six months. Clinical, biological, and echocardiographic data were collected from medical records, standardized interviews, and clinical examinations. Patients were compared according to the ART regimen received: TDF + 3TC + EFV or TDF + 3TC + LPV/r. Statistical analyses were performed using SPSS version 25, with a significance threshold set at $p < 0.05$. **Results:** A total of 154 patients were included, with a mean age of 50.6 ± 12 years; 52.6% were male. No significant differences were observed between groups regarding age, sex, body mass index (BMI), blood pressure, CD4 count (204.5 cells/mm^3), or median viral load (510 copies/mL). Patients receiving LPV/r more frequently presented with asthenia (17.6% vs 3.6%, $p = 0.041$), tachycardia (29.4% vs 14.6%, $p = 0.011$), higher white blood cell counts ($p = 0.028$), and significantly elevated C-reactive protein levels (77.8 vs 40.0 mg/dL, $p = 0.014$). Blood urea levels were also higher in this group ($p = 0.018$). Dilated cardiomyopathy was observed only in patients receiving EFV (16.8%, $p = 0.016$), whereas segmental wall motion abnormalities were more frequent in patients treated with LPV/r (17.6%, $p = 0.030$). **Conclusion:** Cardiac abnormalities and inflamma-

tion are common among people living with HIV receiving ART, with distinct profiles depending on the therapeutic regimen. These findings highlight the need for systematic and individualized cardiovascular monitoring in this population.

Subject Areas

Cardiology

Keywords

Cardiac Abnormalities, HIV, Antiretroviral Therapy, Democratic Republic of the Congo

1. Introduction

Human immunodeficiency virus (HIV) infection remains a major public health problem, particularly in sub-Saharan Africa, where prevalence is high and access to healthcare varies according to socioeconomic contexts [1]. The introduction of antiretroviral therapy (ART) has transformed HIV into a chronic disease, significantly improving the survival of people living with HIV (PLHIV) [2]. However, increased longevity has been accompanied by a rise in non-AIDS-related morbidity, particularly cardiovascular (CV) diseases and structural and functional cardiac abnormalities [3]. Cardiovascular complications associated with HIV may be direct, related to the viral infection itself, or indirect, associated with antiretroviral drug side effects and emerging metabolic comorbidities [4] [5]. The most frequently reported cardiac manifestations include dilated cardiomyopathy, pericardial effusion, pulmonary arterial hypertension, and ventricular systolic and diastolic dysfunction [3] [6].

Echocardiography is an essential non-invasive tool for identifying these abnormalities, as it allows assessment of cardiac structures, ventricular function, and the presence of pericardial effusion or elevated pulmonary arterial pressures [3]. Recent African studies have reported high rates of echocardiographic abnormalities among HIV patients receiving ART, underscoring the importance of cardiovascular monitoring in this population [3] [7] [8].

In the Democratic Republic of the Congo (DRC), epidemiological data on HIV-associated heart disease are scarce, despite historical evidence suggesting that HIV infection may be associated with significant clinical and echocardiographic cardiac lesions [9] [10]. Furthermore, rapid urbanization, epidemiological transition, and aging of PLHIV receiving ART reinforce the importance of local studies aimed at characterizing the frequency and determinants of cardiac abnormalities among HIV patients in hospital settings [11], such as the University Clinics of Kinshasa (UCK). The objective of this study was to determine which ART regimen is most associated with cardiac abnormalities during patient follow-up at the University Clinics of Kinshasa, Democratic Republic of the Congo.

2. Patients and Methods

2.1. Study Design and Population

This was a historical cohort study conducted at the University Clinics of Kinshasa, a national referral and teaching hospital in the Democratic Republic of the Congo, over a period ranging from 2013 to 2020. La collecte de données a été effectué durant la période de 1 juillet à 30 décembre 2023. Data collection was carried out during the period from July 1 to December 30, 2023. The study population consisted of adult patients living with HIV who were followed at the UCK and had been receiving ART for at least six months. Patients aged 18 years and older with confirmed HIV infection according to national diagnostic algorithms and with complete clinical, biological, and echocardiographic data were included. Patients with known congenital heart disease, severe rheumatic valvular heart disease, or documented ischemic heart disease prior to ART initiation, as well as those with incomplete medical records, were excluded.

2.2. Data Collection

Data were collected from medical records and supplemented by standardized interviews and systematic clinical examinations. Clinical variables included sociodemographic characteristics (age, sex), medical and cardiovascular history—particularly hypertension, diabetes mellitus, smoking, and alcohol consumption—as well as clinical parameters such as blood pressure, heart rate, waist circumference, and body mass index. HIV-related data included duration of infection and ART regimen used. Laboratory evaluation included CD4 lymphocyte count, plasma HIV viral load when available, hemoglobin level, and routine biochemical parameters, including serum creatinine, fasting blood glucose, and lipid profile. Biological abnormalities were defined according to the reference standards of the University Clinics of Kinshasa laboratory and current international recommendations. All patients underwent transthoracic echocardiography performed by an experienced cardiologist using standardized equipment, in accordance with the recommendations of the European Society of Cardiology and the American Society of Echocardiography [12]. Echocardiographic assessment included cardiac chamber dimensions, ventricular wall thickness, left ventricular systolic function assessed by ejection fraction using the biplane Simpson method, left ventricular diastolic function assessed by mitral inflow and tissue Doppler analysis, detection of dilated cardiomyopathy, presence of pericardial effusion, and estimation of systolic pulmonary arterial pressure. Cardiac abnormalities were defined based on standardized echocardiographic thresholds. In the event of any abnormality in transmitral flow E/A < 1 or > 2 and between 1 - 2, with OG dilation > 20 cm^2 with or without E/E' > 15. Dilated cardiomyopathy was defined by three criteria: an increase in LVEDD > 56 mm, LVEF < 40%, and global hypokinesis of the LV walls.

2.3. Statistical Analysis

Data were entered and analyzed using SPSS for Windows version 25. Quantitative

variables were expressed as means ± standard deviation or medians with interquartile ranges, depending on distribution, while qualitative variables were presented as frequencies and percentages. Statistical comparisons were performed using Student's t-test or the Mann-Whitney U test for quantitative variables and the χ^2 test or Fisher's exact test for qualitative variables. Logistic regression testing in multivariate analysis using the forward method was used to identify the determinants of cardiac abnormalities, with adjusted OR calculated to measure the degree of association. A p-value < 0.05 was the threshold for statistical significance. The study was conducted in accordance with the principles of the Declaration of Helsinki, ensuring data confidentiality and obtaining informed consent from all participants.

3. Results

The study population was predominantly middle-aged (50.6 ± 12 years), with no significant difference between the two ART regimens (p = 0.884). Age group distribution and sex were comparable between groups, suggesting good baseline demographic homogeneity.

Clinically, certain manifestations differed significantly according to ART regimen. Patients receiving TDF + 3TC + LPV/r more frequently reported physical asthenia (17.6% vs 3.6%, p = 0.041), whereas chest pain and exertional dyspnea were significantly more frequent among patients receiving TDF + 3TC + EFV (p = 0.031 and p = 0.029, respectively). Angina was observed only in the EFV group.

Infectious history showed notable differences: tuberculosis was significantly more frequent among patients treated with EFV (23.4% vs 5.9%, p = 0.008), which may reflect therapeutic choices influenced by clinical context or drug–drug interactions. History of hepatitis, alcohol consumption, and smoking did not differ significantly between groups.

No significant differences were observed in anthropometric parameters (BMI, waist circumference) or hemodynamic parameters (systolic blood pressure, diastolic blood pressure, pulse pressure), indicating a generally comparable baseline cardiovascular burden between the two regimens (Table 1).

Hematological (hemoglobin) and renal parameters (serum creatinine) were similar between the two groups, suggesting comparable renal tolerance of the therapeutic regimens. In contrast, blood urea levels were significantly higher among patients receiving TDF + 3TC + LPV/r (p = 0.018), which may reflect greater metabolic impairment or a more pronounced catabolic state in this group. The lipid profile (total cholesterol, LDL, HDL) showed no significant differences between the two regimens, despite overall elevated LDL levels and low HDL levels, suggesting an increased cardiovascular risk across the entire study population. Glycemic and immunovirological parameters (CD4 count, viral load) were comparable between groups, indicating similar virological and immunological control regardless of the treatment regimen. In contrast, inflammatory markers were significantly higher in patients receiving LPV/r, with increased white blood cell

counts (p = 0.028) and C-reactive protein levels (p = 0.014), reflecting a more pronounced inflammatory state in this group. The erythrocyte sedimentation rate also tended to be higher, although this did not reach statistical significance. Proteinuria was common but similar in both groups (Table 2).

Table 1. Clinical characteristics of patients according to antiretroviral therapy regimen.

Variable	Over all (n = 154)	TDF + 3TC + EFV (n = 137)	TDF + 3TC + LPV/r (n = 17)	p
Age	50.6 ± 12.0	50.9 ± 11.6	48.0 ± 15.1	0.884
<40 years	29 (18.8)	25 (18.2)	4 (23.5)	
40 - 59 years	94 (61.0)	84 (61.3)	10 (58.8)	
≥60 years	31 (20.1)	28 (20.4)	3 (17.6)	
Sex				0.229
Male	81 (52.6)	74 (54.0)	7 (41.2)	
Female	73 (47.4)	63 (46.0)	10 (58.8)	
Physical asthenia	8 (5.2)	5 (3.6)	3 (17.6)	**0.041**
Chest pain	20 (13.0)	19 (13.9)	1 (5.9)	**0.031**
Angina pectoris	7 (4.5)	7 (5.1)	0 (0.0)	-
Exertional dyspnea	50 (32.5)	46 (33.6)	4 (23.5)	**0.029**
Cardiac palpitations	22 (14.3)	20 (14.6)	2 (11.8)	0.549
Hypertension	35 (22.7)	30 (21.9)	5 (29.4)	0.335
Blood transfusion	22 (14.3)	51 (15.3)	1 (5.9)	**0.026**
Tabacco consumption	9 (5.8)	9 (6.6)	0 (0.0)	-
Alcohol consumption	23 (14.9)	23 (16.8)	0 (0.0)	0.054
Tuberculosis	33 (21.4)	32 (23.4)	1 (5.9)	0.008
Hepatitis	18 (11.7)	18 (13.1)	0 (0.0)	0.106
SBP (mmhg)	127.2 ± 26.4	128.0 ± 25.8	120.9 ± 31.4	0.298
DBP (mmhg)	78.8 ± 15.3	79.5 ± 15.0	72.9 ± 16.8	0.095
PP (mmhg)	48.4 ± 16.7	48.5 ± 16.2	47.9 ± 21.3	0.903
BMI (Kg/m2)	23.1 ± 4.8	23.2 ± 4.9	22.2 ± 3.5	0.403
WC (cm)	89.2 ± 9.1	89.4 ± 9.1	88.0 ± 9.2	0.553

BMI: Body mass index; WC: Waist circumference; PP: Pulse pressure; DBP: Diastolic blood pressure; SBP: Systolic blood pressure.

Table 2. Biological characteristics according to antiretroviral therapy regimen.

Variable	Over all (n = 154)	TDF + 3TC + EFV (n = 137)	TDF + 3TC + LPV/r (n = 17)	p
Hemoglobin (g/dL)	10.4 ± 2.9	10.4 ± 2.8	10.5 ± 3.2	0.872
Serum creatinine (mg/dL)	1.05 (0.99 - 1.40)	1.05 (1.0 - 1.40)	1.10 (0.90 - 6.59)	0.451
Blood urea (mg/dL)	25.0 (18.4 - 41.1)	23.0 (18.3 - 37.3)	33.5 (24.9 - 91.0)	**0.018**

Continued

Total cholesterol (mg/dL)	177.5 (149.0 - 200.0)	177.4 (148.0 - 200.0)	187.0 (147.8 - 200.8)	0.518
LDL-c (mg/dL)	141.0 (112.9 - 168.3)	140.0 (112.8 - 166.5)	144.0 (111.7 - 172.1)	0.716
HDL-c (mg/dL)	28.0 (19.0 - 45.9)	27.0 (19.0 - 45.3)	32.0 (20.0 - 51.5)	0.385
Fasting blood glucose (mg/dl)	101.0 (90.0 - 152.0)	101.0 (90.0 - 152.0)	111.0 (94.0 - 184.0)	0.263
CD4 (cells/mm³)	204.5 (120.0 - 374.5)	220.0 (123.5 - 390.0)	143.0 (103.0 - 289.0)	0.144
HIV viral load (copies/mL)	510.0 (32.8 - 2625.0)	500.0 (32.0 - 3000.0)	1000.0 (46.5 - 2060.0)	0.566
WBC (cells/mm³)	6.4 (4.7 - 8.8)	6.1 (4.6 - 8.6)	8.7 (6.1 - 10.0)	**0.028**
ESR (mm/h)	77.5 (34.0 - 110.0)	75.2 (33.0 - 110.0)	100.0 (72.1 - 114.8)	0.089
CRP (mg/dL)	44.5 (18.0 - 91.7)	40.0 (15.0 - 88.3)	77.8 (45.0 - 94.4)	**0.014**
Proteinuria	118 (76.6)	105 (76.6)	13 (76.5)	0.937

LDL-C: Low-density lipoprotein cholesterol; HDL-C: High-density lipoprotein cholesterol; WBC: White blood cell count; ESR: Erythrocyte sedimentation rate; CRP: C-reactive protein.

Echocardiographic abnormalities were overall frequent in the study population. Tachycardia was significantly more common among patients receiving TDF + 3TC + LPV/r (29.4% vs 14.6%, p = 0.011), suggesting a greater hemodynamic or inflammatory impact in this group. Dilated cardiomyopathy (DCM) was observed exclusively in patients treated with EFV (16.8%, p = 0.016), which may reflect a longer duration of infection or treatment-independent associated factors. Systolic dysfunction (reduced left ventricular ejection fraction) and diastolic dysfunction were present but did not differ significantly between the two groups. Segmental wall motion abnormalities were significantly more frequent in patients receiving LPV/r (p = 0.030), suggesting more severe myocardial involvement or a higher cardiovascular risk profile in this group. Other abnormalities, including left ventricular hypertrophy, pericardial effusion, and myocardial wall thickening, did not differ significantly between groups (Table 3).

Table 3. Echocardiographic characteristics according to antiretroviral therapy regimen.

Cardiac abnormality	Over all (n = 154)	TDF + 3TC + EFV (n = 137)	TDF + 3TC + LPV/r (n = 17)	p
Tachycardia	25 (16.2)	20 (14.6)	5 (29.4)	**0.011**
Diastolic dysfunction	24 (15.6)	22 (16.1)	2 (11.8)	0.485
Left ventricular hypertrophy	24 (15.6)	21 (15.3)	3 (17.6)	0.515
Dilated cardiomyopathy	23 (14.9)	23 (16.8)	0 (0.0)	**0.016**
Impaired relaxation	14 (9.1)	13 (9.5)	1 (5.9)	0.525
Reduced LVEF	13 (8.4)	12 (8.8)	1 (5.9)	0.566
Pericardial effusion	10 (6.5)	8 (5.8)	2 (11.8)	0.304
Ventricular wall thickening	9 (5.8)	8 (5.8)	1 (5.9)	0.661
Dyskinesia	7 (4.5)	4 (2.9)	33 (17.6)	**0.030**

LVEF: Left ventricular ejection fraction.

Multivariate analysis highlights several independent determinants of cardiac abnormalities, particularly for tachycardia and dyskinesia. With regard to tachycardia, age ≥ 60 years appears to be the only significantly associated factor, with a 2.47-fold increase in risk compared to subjects under 40 years of age (aOR = 2.47; 95% CI: 1.59 - 4.79; p = 0.022), while the TDF + 3TC + LPV/r treatment regimen is associated with an increased risk of tachycardia (aOR = 2.73; 95% CI: 1.77 - 9.68; p = 0.012). With regard to dyskinesia, several independent factors emerged as significant. Age ≥ 60 years was the most important determinant, with a 5.44-fold increase in risk (aOR = 5.44; 95% CI: 2.30 - 7.47; p = 0.002). Female gender was also associated with a significant increase in the risk of dyskinesia (aOR = 3.53; 95% CI: 1.70 - 9.10; p = 0.008), and a history of tuberculosis was significantly linked to dyskinesia (aOR = 2.69; 95% CI: 1.61 - 5.68; p = 0.012), and the TDF + 3TC + LPV/r treatment regimen is associated with an increased risk of dyskinesia (aOR = 7.56; 95% CI: 3.59 - 13.40; p = 0.019) compared to the TDF + 3TC + EFV regimen (Table 4).

Table 4. Determinants of cardiac abnormalities in multivariate analysis.

Variable	Tachycardia		Dyskinesia	
	p	aOR (95% CI)	p	aOR (95% CI)
Age				
<40 years		1		1
40 - 59 years	0.733	1.80 (0.23 - 2.81)	0.791	1.45 (0.92 - 2.84)
≥60 years	**0.022**	2.47 (1.59 - 4.79)	**0.002**	5.44 (2.30 - 7.47)
Gender				
Male		1		1
Female	0.760	1.17 (0.42 - 3.28)	**0.008**	3.53 (1.70 - 9.10)
Transfusion				
No		1		
Yes	0.682	1.40 (0.28 - 2.94)	0.243	1.03 (0.25 - 1.29)
Tabacco				
No		1		1
Yes	0.955	1.07 (0.09 - 1.22)	0.589	1.19 (0.25 - 2.97)
Alcohol				
No		1		1
Yes	0.650	1.38 (0.34 - 5.54)	0.697	1.36 (0.59 - 2.36)
TBC				
No		1		1
Yes	0.912	1.08 (0.29 - 1.06)	0.012	2.69 (1.61 - 5.68)
BMI (Kg/m2)*	0.127	1.12 (0.97 - 1.30)	0.284	1.23 (0.84 - 1.80)
WC*	0.162	0.94 (0.87 - 1.02)	0.893	1.01 (0.83 - 1.23)

Continued

Total cholesterol*	0.443	1.04 (0.99 - 1.16)	0.401	1.02 (0.98 - 1.05)
CD4 (cells/mm3)	0.932	1.00 (0.99 - 1.03)	0.536	0.99 (0.98 - 1.06)
Therapeutic regimen				
TDF + 3TC + EFV		1		1
TDF + 3TC + LPV/r	**0.012**	2.73 (1.77 - 9.68)	**0.019**	7.56 (3.59 - 13.40)

4. Discussion

In this study, the population was predominantly middle-aged (50.6 ± 12 years), with no significant difference between patients receiving TDF + 3TC + EFV and those receiving TDF + 3TC + LPV/r. This distribution is consistent with African and international data showing a progressive aging of people living with HIV (PLHIV), a direct consequence of the effectiveness and increasing accessibility of antiretroviral therapy (ART) [11] [13]. The absence of significant differences in age and sex between therapeutic groups suggests good baseline demographic homogeneity, thereby limiting the risk of confounding bias and strengthening the internal validity of the observed comparisons. Similar findings have been reported in African and European cohorts comparing non-nucleoside reverse transcriptase inhibitor (NNRTI)-based regimens and boosted protease inhibitor (PI)-based regimens [14].

The clinical differences observed according to ART regimen are particularly noteworthy. Physical asthenia was significantly more frequent among patients receiving TDF + 3TC + LPV/r. This symptom is commonly described in patients treated with protease inhibitors and may be related to persistent systemic inflammation, metabolic disturbances, or indirect mitochondrial toxicity [15]. In contrast, chest pain, exertional dyspnea, and angina were more frequently reported among patients receiving EFV. These manifestations may reflect more longstanding cardiovascular disease or an underlying coronary condition, independent of the current treatment. Efavirenz has been associated in some studies with neurovegetative effects and rhythm disturbances that may increase the perception of cardiorespiratory symptoms [16].

The significantly higher prevalence of tuberculosis among patients receiving EFV is consistent with international therapeutic recommendations, which have historically favored efavirenz-based regimens in patients co-infected with tuberculosis because of more favorable drug-drug interactions with rifampicin compared with boosted protease inhibitors [17]. This difference highlights that ART regimen choice may be influenced by prior clinical context, which must be considered when interpreting cardiovascular and inflammatory outcomes. The absence of differences in hepatitis history, smoking, and alcohol consumption suggests comparable exposure to traditional cardiovascular risk factors between groups. Anthropometric (BMI, waist circumference) and hemodynamic parameters (systolic blood pressure, diastolic blood pressure, pulse pressure) were comparable between the two groups. These findings are consistent with several studies

showing that cardiovascular differences observed between ART regimens are not always mediated by traditional risk factors, but rather by inflammatory, metabolic, and endothelial mechanisms specific to therapeutic classes [18].

From a renal perspective, the lack of significant differences in serum creatinine between groups suggests overall comparable renal tolerance of tenofovir disoproxil fumarate (TDF) in both regimens. However, the significantly higher blood urea levels among patients receiving LPV/r may reflect an increased catabolic state, relative dehydration, or more pronounced systemic inflammation, as suggested by previous studies in patients treated with protease inhibitors [19].

The globally unfavorable lipid profile (elevated LDL and low HDL) observed across the entire population confirms the increased cardiovascular risk among PLHIV, regardless of ART regimen. Contrary to historical data strongly associating protease inhibitors with dyslipidemia, some recent studies suggest an attenuation of these differences, likely related to improved overall patient management and evolving therapeutic formulations [20]. Inflammatory markers (white blood cell count and CRP), which were significantly higher among patients receiving LPV/r, represent a central finding of this study. Persistent inflammation under boosted protease inhibitors has been well documented and has been associated with an increased risk of cardiovascular events, independent of virological control [18] [21]. The trend toward a higher erythrocyte sedimentation rate further supports this hypothesis. The absence of significant differences in CD4 counts and viral load between groups indicates similar virological and immunological control. This finding suggests that the observed clinical, biological, and echocardiographic differences are not related to differential antiretroviral efficacy, but rather to class-specific effects of ART on cardiovascular and inflammatory pathways, as previously reported in several longitudinal cohorts [22]. Echocardiographic abnormalities were frequent in the study population, confirming that subclinical cardiac involvement remains common among PLHIV. The significantly higher frequency of tachycardia among patients receiving LPV/r may reflect chronic inflammatory status, increased sympathetic activation, or autonomic dysfunction—mechanisms widely described in patients treated with protease inhibitors [23]. Dilated cardiomyopathy, observed exclusively among patients receiving EFV, may reflect longer-standing HIV infection, prolonged exposure to deleterious myocardial factors, or causes independent of current treatment. Studies have shown that dilated cardiomyopathy in PLHIV is often multifactorial, involving chronic inflammation, direct myocardial involvement, and co-infections [24]. The higher prevalence of segmental wall motion abnormalities among patients receiving LPV/r suggests more severe myocardial involvement or a higher-risk coronary profile, potentially related to persistent inflammation and endothelial dysfunction associated with boosted protease inhibitors [25].

The present multivariate analysis highlights the determining role of advanced age and protease inhibitor–based therapeutic regimens in the occurrence of cardiac abnormalities, while dyskinesia is additionally influenced by female sex and

a history of tuberculosis. These findings should be interpreted in the context of the progressive aging of the population living with HIV, which is a direct consequence of improved survival under antiretroviral therapy. Age ≥ 60 years appears to be the most consistent and strongest factor, associated with both tachycardia (aOR = 2.47) and dyskinesia (aOR = 5.44). Cardiovascular aging is characterized by increased arterial stiffness, progressive myocardial fibrosis, impaired ventricular compliance, and alterations in the cardiac conduction system [26]. In people living with HIV, these mechanisms may be amplified by persistent chronic inflammation and residual immune activation, even in the setting of effective viral suppression. HIV infection is recognized as a chronic pro-inflammatory state that promotes accelerated atherosclerosis, endothelial dysfunction, and cardiac remodeling [27]. Furthermore, cohort studies have shown that individuals with HIV have a higher risk of major cardiovascular events compared with uninfected individuals, independently of traditional cardiovascular risk factors [28]. The strong association observed with dyskinesia may reflect more structural and segmental myocardial damage resulting from the cumulative burden of inflammatory and metabolic insults over time. The TDF + 3TC + LPV/r regimen also constitutes a major determinant, being associated with an increased risk of tachycardia (aOR = 2.73) and, more markedly, dyskinesia (aOR = 7.56), compared with the TDF + 3TC + EFV regimen. Protease inhibitors, particularly lopinavir/ritonavir, have been implicated in an increased overall cardiovascular risk. The Data Collection on Adverse Events of Anti-HIV Drugs study demonstrated a significant association between cumulative exposure to protease inhibitors and the risk of myocardial infarction [29]. Proposed mechanisms include drug-induced dyslipidemia, insulin resistance, fat redistribution, endothelial dysfunction, and mitochondrial toxicity. Beyond coronary events, these metabolic disturbances may promote ventricular remodeling and impair segmental contractility, which could explain the particularly strong association observed with dyskinesia. Tachycardia, on the other hand, may result from autonomic imbalance or subclinical involvement of the cardiac conduction system in a context of systemic inflammation. Female sex was significantly associated with dyskinesia (aOR = 3.53). This finding suggests a specific vulnerability of women to myocardial functional alterations in the context of HIV infection. Some data indicate that women living with HIV exhibit a distinct inflammatory profile and immune response compared with men, which may influence cardiovascular remodeling [30]. In addition, hormonal differences, particularly the decline in estrogen levels after menopause, may increase susceptibility to ventricular dysfunction. Although studies focusing specifically on segmental wall motion abnormalities are limited, the literature highlights gender disparities in the presentation and recognition of cardiovascular diseases, which are often underdiagnosed in women. A history of tuberculosis was also associated with dyskinesia (aOR = 2.69). Tuberculosis is a systemic disease capable of inducing prolonged inflammation and indirect cardiovascular involvement. Even in the absence of overt pericardial disease, chronic inflammation and persistent immune activation may con-

tribute to myocardial remodeling [31]. In the context of HIV-tuberculosis co-infection, the intensity of the inflammatory response is often heightened, which may favor the segmental contractility abnormalities observed. Additionally, pharmacological interactions between antituberculous and antiretroviral drugs may alter plasma drug concentrations and potentially influence cardiovascular toxicity.

5. Study Limitations

This study has several limitations that should be considered when interpreting the results. The cross-sectional design does not allow causal inference between ART regimens and the observed clinical, biological, or echocardiographic abnormalities. Although echocardiography was performed according to international guidelines by an experienced cardiologist, it remains an operator-dependent technique, and the absence of independent reading or interobserver reproducibility assessment may introduce measurement bias. In addition, the lack of an HIV-negative control group prevents clear distinction between the respective contributions of HIV infection itself, aging, traditional cardiovascular risk factors, and specific antiretroviral regimen effects to the observed cardiac abnormalities.

Despite these limitations, the findings reinforce the importance of a multidisciplinary approach involving infectious disease specialists, cardiologists, and laboratory physicians in the care of PLHIV. They also support the need to tailor ART regimen selection by taking individual cardiovascular risk profiles into account, particularly in resource-limited settings.

6. Conclusion

This study highlights a high prevalence of clinical, biological, and echocardiographic abnormalities among adult patients living with HIV and receiving antiretroviral therapy at the University Clinics of Kinshasa. Despite overall comparable immunovirological control between the TDF + 3TC + EFV and TDF + 3TC + LPV/r regimens, significant differences in clinical, inflammatory, and cardiac profiles were observed according to the antiretroviral treatment used. The EFV-based regimen was more frequently associated with functional cardiorespiratory symptoms, a history of tuberculosis, and the exclusive presence of dilated cardiomyopathy, suggesting chronic myocardial involvement potentially related to longer duration of infection or treatment-independent associated factors. In contrast, the LPV/r-containing regimen was associated with significantly higher blood urea levels, more frequent tachycardia, and increased segmental wall motion abnormalities, reflecting potentially more severe hemodynamic and myocardial involvement.

Conflicts of Interest

The authors declare no conflicts of interest.

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