Prevalence of atrial fibrillation among people living with HIV-1 on highly active antiretroviral therapy and its relationship with CD4 cell count and viral load at Federal Medical Centre Nguru a tertiary hospital in Yobe state, Northeastern Nigeria

Baba, M.M., Abdul, H., Ayodele, A.A., Goni, B.W., Mairari, F.G

[1]Department of Cardiology, Yobe State University College of Medical Sciences, Damaturu , Nigeria
[2]Department of Cardiology, Yobe State University Teaching Hospital Damaturu, Nigeria
[3]Gombe state University College of Medical Sciences, Gombe, Nigeria
[4]Department of Infectious Disease Yobe State University Teaching Hospital, Damaturu, Nigeria
[5]Department of Physiology Yobe State University College of Medical Sciences, Damaturu, Nigeria

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Corresponding author:
Baba, M.M.
drbaba01@gmail.com

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Abstract

Introduction: HIV infection was reported to be independently associated with an increased risk of atrial fibrillation, low CD4 cell count and high viral load were found to be strongly associated with atrial fibrillation. The objectives of this study was to determine the prevalence of atrial fibrillation and its relationship with CD4 cells count and viral load among people living with HIV-1 on highly active antiretroviral therapy (HAART).
Materials and method: The study was a cross-sectional conducted among PLWHIV receiving HAART. CD4 cells count, viral load measurement and electrocardiography were done for all consented patients.
Results: One hundred (100) subjects were recruited into the study comprising thirty-three (33.0%) males and 67(67.0%) females. The mean CD4 cells count and viral load of the studied patients were 614.99 ± 34.92 cells/μL and 4654±58.79 copies/mL, respectively. The prevalence of atrial fibrillation in this study was found to be 5.0%. Low CD4 cells count and high viral load were found to be associated atrial fibrillation (P = < 0.01 and P = < 0.01 respectively).
Conclusion: The study showed a low prevalence of atrial fibrillation among PLWHIV on HAART. Low CD4 cells count and high viral load were found to be associated with atrial fibrillation.

Prévalence de la fibrillation auriculaire chez les personnes vivant avec le VIH-1 sous traitement antirétroviral hautement actif et sa relation avec le nombre de cellules CD4 et la charge virale au Centre médical fédéral Nguru, un hôpital tertiaire de l'État de Yobe, au nord-est du Nigéria

Résumé
Introduction : L'infection par le VIH a été associée de manière indépendante à un risque accru de fibrillation auriculaire, un faible taux de cellules Cd4 et une charge virale élevée se sont avérés fortement associés à la fibrillation auriculaire. Les objectifs de cette étude étaient de déterminer la prévalence de la fibrillation auriculaire et sa relation avec le taux de cellules CD4 et la charge virale chez les personnes vivant avec le VIH-1 sous traitement antirétroviral hautement actif (HAART).
Matériel et méthode : L'étude était transversale et menée auprès de personnes vivant avec le VIH sous HAART. Le nombre de cellules CD4, la mesure de la charge virale et l'électrocardiographie ont été effectués pour tous les patients consentants.
Résultats : Cent (100) sujets ont été recrutés dans l'étude comprenant trente-trois (33,0 %) hommes et 67 (67,0 %) femmes. Le nombre moyen de cellules CD4 et la charge virale des patients étudiés étaient respectivement de 614,99 ± 34,92 cellules/μL et de 4654 ± 58,79 copies/mL. La prévalence de la fibrillation auriculaire dans cette étude était de 5,0 %. Un faible nombre de cellules CD4 et une charge virale élevée étaient associés à la fibrillation auriculaire (P = < 0,01 et P = < 0,01 respectivement).
Conclusion : L'étude a montré une faible prévalence de la fibrillation auriculaire chez les PVVIH sous HAART. Un faible nombre de cellules CD4 et une charge virale élevée étaient associés à la fibrillation auriculaire.

INTRODUCTION

Human immunodeficiency virus (HIV) pandemic continues to be a major public health problem globally. Nigeria has a HIV prevalence of 2.1% among adults aged 15–49 years which corresponds to approximately two million people living with HIV (PLWHIV), with Yobe state having the lowest prevalence of 0.4% (1). The introduction of highly active antiretroviral therapy (HAART) has changed the natural history of HIV as well as the morbidity and mortality associated with the disease (2). However, PLWHIV remain at increased risk of cardiovascular diseases and sudden cardiac death (3). Cardiovascular events, such as myocardial infarction, heart failure, sudden cardiac death, and stroke are more common among PLWHIV compared with HIV negative individuals (4-7). Previous studies have shown that atrial fibrillation (AF) is associated with a transient ischemic attack, ischemic stroke, systemic embolism, heart failure, cognitive decline, and dementia (8). Sardana *et`al* reported that HIV infection was independently associated with an increased risk of atrial fibrillation (9). Similarly, Hsu *et al* reported that both CD4 cells count and viral load were independently associated with an increased risk of AF (10). A systematic review study by Daniele *et`al* reported a prevalence of AF among PLWHIV ranging from 2.0% to 5.13%, their study further revealed that low CD4 cells count and high viral load were predictors of AF (11). While Osuji *et`al* reported a prevalence of 3.0% (12). However, most of the studies done in Nigeria were focused on electrocardiographic abnormalities among PLWHIV (13-15). To the best of our knowledge, there are few studies on atrial fibrillation among PLWHIV and its relationship with CD4 cells count in Nigeria population. Therefore the objectives of this study was to determine the prevalence of atrial fibrillation and its relationship with CD4 cells count and viral load among people leaving with HIV-1 to enable clinicians to predict the risk of atrial fibrillation among PLWHIV.

MATERIALS AND METHOD

The study was a cross-sectional conducted among people leaving with HIV-1 receiving HAART at the ART clinic of Federal Medical Centre Nguru, Yobe State, North Eastern Nigeria. The sample size for the study was calculated using the formula:

$$\frac{N=Z^2 P(P-1)^2}{D^2}$$

Where N = Sample size, Z= Level of confidence at 95% (1.96), P =Prevalence and D =Margin of error at 5% (0.05). Using the prevalence of AF among PLWHIV as 5.13% a sample size of seventy (70) was calculated. However, to increase the power of the study the sample size was increased to one hundred (100). Ethical approval for the study was obtained from the Ethics and Research Committee of the Federal Medical Centre Nguru Yobe State, Nigeria (study reference number: FMC/N//CLSERV/355/VOL III/155 dated 11 January, 2022).

All studied participants signed an informed consent form after been fully explained before enrolment. As part of our exclusion criteria, hypertensive patients and patients with echocardiographic evidence of rheumatic heart disease were excluded from the study. Other exclusion criteria were patients with history of heart disease predating the diagnosis of HIV infection, patients with thyrotoxicosis, diabetes mellitus, obesity, obstructive sleep apnoea as well as patients with significant history of cigarette smoking and alcohol consumption. Participants were categorized into three groups based on CD4 cells count according to United State Centre for Disease Control (CDC) classification as follows: CD4 cell count <200 cells/µL, CD4 cell count 200–499 cells/µL and CD4 cells count ≥500 cells/mL (16) and viral load according to World Health Organisation (WHO) (17) as follows: Undetectable (<50 copies/mL), suppressed viral load (50-1000 copies/mL) and unsuppressed viral load (>1000 copies/mL) After considering the exclusion criteria, consented adult (age ≥18 years) people leaving with HIV-1 were recruited into the study using a convenience sampling method. Information on socio-demographic and clinical characteristics of the participants were obtained from their respective clinical case notes. General physical examination including anthropometric measurements were carried out for all study participants, their body mass indices (BMI) were calculated. All participants had full cardiovascular and respiratory system examinations, fasting blood glucose, fasting lipid profile, serum electrolytes, urea, creatinine and packed cell volume (PCV) done. CD4 cells count and viral load estimation were done using Cyflow laser product Patec GmbH Am plus Platz 13 D028282010 and Cobas Ampliprep Cobas tagman (48 samples per batch) model 395808 Ampliprep/4312 machines, respectively.

Electrocardiography was done by electrocardiographic technician using electrocardiogram machine model -12 Express

(serial number SE122B0911291BF Shanghai international Holding Corp.GmbH (Europe). Edan Instrument, Inc. 3/F-B Nanshan medical equipment Park Nanhai). While the ECG interpretation was done by the first author, atrial fibrillation was diagnosed based on absent of discernable atrial activity (P-wave) and irregular ventricular depolarisation (irregular R-R interval) using Lead II as the rhythm strip.

Data Analysis:

Statistical analysis was done using SPSS version 27.0 (IBM SPSS Statistics), data were presented as mean ± standard deviation (SD) for continuous variables, categorical variables were expressed as frequencies and proportions while Fishers exact tests was used to test for significant difference between two categorical variables with less than 5 entries. A P value of < 0.05 was considered as significant.

RESULTS

Demographic and clinical characteristics of the studied population

One hundred (100) participants were recruited into the study comprising thirty-three (33.0%) males and 67(67.0%) females. The mean age, body mass index (BMI) and duration of HIV treatment in years of the studied participants were 37.12±9.60, 22.03±1.88 and 5.38±2.17, respectively. The mean systolic and diastolic blood pressure of the studied participants were 126.70±10.15 and 81.80±7.16 respectively.

Laboratory findings among the studied Population:

In this study, one participant (1.0%) had HIV/Hepatitis B virus (HBV) co-infection and none had Hepatitis C virus (HCV) co-infection. The mean packed cell volume (PCV) and estimated glomerular filtration rate (eGFR) of the studied participants were 31.03±5.86 % and 77.89±3.31mls/min respectively. The mean CD4 cells count and viral load of the studied participants were 614.99 ± 34.92 cells/µL and 4654±58.79 copies/ml, respectively. The mean serum electrolytes, urea, creatinine, fasting lipids profile and fasting blood glucose of the studied participants were within normal limit as follows: Sodium 139.80±3.38mmol/L, Potassium 3.59±0.34 mmol/L, Chloride 105.42±3.83mmol/L, Bicarbonate 22.56±21.11mmol/L, Urea 6.43±3.0mmol/L Creatinine 120.86±39.43µmol/L, Total cholesterol 4.06±0.57mmol/L, Low density lipoprotein (LDL) cholesterol 2.26±0.49mmol/L, High density lipoprotein (HDL) cholesterol 1.27±0.14mmol/L, Triglycerides 2.02±0.44mmol/L and the fasting blood glucose was 4.54±0.62mmol/L. However, analysis of variance (Anova) of mean values of sodium, urea and creatinine across the CD4 cells count groups showed a significant difference. On post hoc analysis, significant difference was only observed between CD4 cells group <200 cells/µL and ≥500 cells/µL (P = 0.008, < 0.001, and < 0.001) respectively. Similarly, a significant difference was also observed in mean values of sodium, urea, creatinine and fasting total cholesterol across the different viral load groups. However, on post hoc analysis the significant difference was only found between viral load groups <50 copies/ml and >1000 copies/ml (P = 0.024, < 0.001, < 0.001 and <0.001) respectively. Table 1 showed laboratory results according to CD4 cells count and viral load of the studied population.

The CD4 cells count distribution of the studied participants according to CDC classification of HIV disease severity showed that twelve (12.0%) patients had CD4 cells count of < 200 cells/µL (severe disease), 30(30.0%) patients had CD4 cells count range 200-499 cells/µL (moderate disease) and 58(58.0%) patients had CD4 cells count ≥500 cells/µL (mild disease). On the other hand, the distribution of viral load according to WHO classification of HIV disease severity showed that 13(13.0%) patients had undetectable viral load (<50) copies/ml, 40(40.0%) patients had suppressed viral load (50-1000) copies/ml and 47(47.0%) patients had unsuppressed viral load (>1000) copies/mL.

The distribution of Highly Active Antiretroviral Therapy (HAART) among the studied population

Forty four (44.0%) patients were on Zidovudine/Lamivudine/Nevirapine regimen of HAART (AZT/3TC/NVP), 33(33.0%) were on Tenofovir/Lamivudine/Efavirenz regimen (TDF/3TC/EFV), 23(23.0%) were on Zidovudine/Lamivudine/Efavirenz regimen (AZT/3TC/EFV) and none of the patients were on Protease Inhibitors.

Electrocardiographic findings of the studied population

The prevalence of atrial fibrillation in this study was found to be 5.0% and none had atrial flutter. Sinus rhythm was observed in 68(68%) patients, thirty (30.0%) patients had

premature ventricular contraction (PVCs), 16(16.0%) had unifocal PVC while 14(14.0%) had multifocal PVC. Twenty-seven (27.0%) patients had sinus tachycardia while non-specific intraventricular conduction defect (NSIVCD) was seen in 27 (27.0%) patients. Table 2 showed the distribution of electrocardiographic findings among the studied population. Subgroup analysis according to CD4 cells count revealed that only one (7.1%) out of the twelve patients with CD4 cells count < 200 cells/μL had sinus rhythm, 6(57.1%) patients had sinus tachycardia while 5(35.7%) patients had atrial fibrillation. Most of the ECG abnormalities observed in this study were seen among patients with low CD4 cells count and there was a statistically significant difference in these ECG findings between patients with low and high CD4 cells count. Table 3 showed the electrocardiographic findings according to CD4 cells count.

Similarly, the ECG findings according to viral load revealed that all the 13(100.0%) patients with undetectable viral load (<50 copies/mL) had sinus rhythm, and only 15(31.9%) out of 47 patients with viral load > 1000 copies/ml had sinus rhythm. Atrial fibrillation was only seen among patients with CD4 cells count < 200 cells/μL and viral load > 1000 copies/ml. Table 4 showed the electrocardiographic findings according to viral load.

DISCUSSION

Cardiovascular manifestation of HIV has long been described in several studies in the past, these include: pericarditis, myocarditis, cardiomyopathies, pulmonary hypertension and coronary artery disease (3-7). A substantial proportion of the study subjects were in their productive age group with female participants constituting a relatively higher proportion of patients. This finding is similar to that reported by Onovo *et àl* in a Bayesian predictive modelling study on estimation of HIV prevalence and burden in Nigeria (1). The laboratory results of the studied participants showed that the mean serum electrolytes, urea, creatinine, fasting blood glucose, fasting lipids profile and packed cells volume were all within the normal limit. However, there was a statistically significant difference in the mean values of these parameters across the CD4 cells count and viral load groups. The differences became very clear between patients with low and high CD4 cells count as well as between low and high viral load groups. These findings suggest that HIV disease severity is associated with electrolytes derangement which could be due to recurrent diarrhoea and vomiting from opportunistic infection as previously reported (18). Similarly the study also revealed a high proportion of patients with low CD4 cells count and high viral load had anaemia and low eGFR. These findings are also in keeping with earlier studies that revealed patients with severe HIV disease are at an increased risk of anaemia, and decrease renal function (19, 20). The pathophysiologic bases of anaemia in HIV disease could be due to direct effect of the HIV on bone marrow, nutritional deficiencies, and HIV associated nephropathy (19, 20). Total cholesterol was observed to be higher among patients with higher viral load suggesting that HIV disease severity could be responsible for the hypercholesterolaemia rather than antiretroviral induced which is known to be associated with dyslipidaemia (21).

HIV infection was reported to be significantly associated with increased risk of atrial fibrillation (9-11). This study revealed a prevalence of 5.0% which is similar to the earlier study by Daniele and colleagues and slightly higher than that reported by Osuji *et`a*l (2.0% to 5.13%) and (3.0%) respectively (11, 12).This study further revealed that all the patients with atrial fibrillation had low CD4 cells count and relatively high viral load. This also support the earlier findings reported by Sardana *et`a*l (9) and Jonathan *et`al* (10).The pathophysiologic mechanism linking HIV infection and atrial fibrillation could be attributed to chronic inflammation, myocarditis and electrolyte derangement associated with disease severity seen in patients with advanced disease (i.e. low CD4 cells count and high viral load) (22). Majority of the studied participants had normal sinus rhythm which is comparable to those reported by other workers. Premature ventricular contractions were the commonest abnormal cardiac rhythm followed by nonspecific intraventricular conduction defect and sinus tachycardia. All PVCs as well as NSIVCD were observed among patients with advanced HIV disease (i.e. with lower CD4 cells count and higher viral load). These findings may not be unconnected with HIV disease severity associated with myocarditis as described above (22). A possible explanation for sinus tachycardia among the patients in this study could be due to anxiety, anaemia or opportunistic infections causing fever with resultant tachycardia as often seen in HIV infected patients. Majority of the patients had no evidence of bundle branch block,

however few patients had RBBB, LBBB and left posterior hemi block (right axis deviation). The findings of RBBB and left posterior hemi block in this study may be due to high probability of pulmonary hypertension in patients with advanced HIV disease previously reported (23). Similarly, high proportion of the studied participants had normal corrected QT interval (QTc), while nearly one-fifth of them had prolong QTc interval. The study further elucidated that those patients with prolonged QTc had had advance disease (i.e. low CD4 cells count and high viral). This finding is similar to those earlier reported by Mahmud *et`al* (15). Literature search revealed that there are several cardiac and non-cardiac causes of QTc prolongation which include but limited to these conditions: cardiac (myocardial ischemia or myocarditis), medications such as antiarrhythmic, antipsychotics, antihistamines, antibiotics, antiretrovirals, antifungals and electrolytes abnormalities such as hypokalemia, hypomagnesemia and hypocalcemia. Other conditions associated with prolonged QTc include hypothyroidism and intracranial pathology. In this study however, patients with thyroid disease were excluded and none of these patients were on antiarrhythmic, antipsychotics or protease inhibitor class of antiretroviral drugs. However, serum magnesium and calcium levels of the studied participants were not analysed which could be a limitation of the study.

CONCLUSION

The study revealed a prevalence of atrial fibrillation among people leaving with HIV on HAART as 5.0%, and that low CD4 cells count and high viral load were found to be associated with atrial fibrillation.

Study limitations: The study was cross-sectional and thus no follow up of patients to determine if improvement in CD4 cells count and virologic suppression following adequate treatment can restore sinus rhythm and perhaps reverse some of the abnormalities observed. Secondly, the study had no control participants for comparison. Lastly the study participants were only one hundred therefore, there is need to have a large multi centred prospective study to determine the relationship between atrial fibrillation with viral load and CD4 cells count.

Recommendations: From the findings of this study, we therefore recommend that people leaving with HIV particularly those with advanced disease should be routinely be evaluated for cardiac arrhythmias such atrial fibrillation and other rhythm abnormalities that are associated with increased risks of cardiovascular disease.

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Author's contribution: Authors have substantially contributed in designing, literature review, data collection, analysis, interpretation of the result and discussion.

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Table 1: L aboratory results according to CD4 cells count and viral load of the studied population

Mean CD4 cells count (cells/µL)	**<200**	**200-499**	**≥ 500**	**Anova P -value**
Sodium (mmol/L)	137.50±4.83	139.06±3.50	140.65±2.65	< 0.001*
Potassium(mmol/L)	3.39±0.31	3.58±0.30	3.65±0.36	0.166
Chloride(mmol/L)	107.91±4.48	106.06±4.09	104.56±3.29	0.350
Bicarbonate(mmol/L)	19.25±1.42	17.83±3.05	25.68±2.72	0.287
Urea(mmol/L)	9.86±1.86	8.30±2.94	4.75±1.84	0.002*
Creatinine(µmol/L)	152.58±34.24	147.86±38.78	100.32±26.17	0.006*
FBG (mmol/L)	4.55±0.37	4.67±0.92	4.48±0.44	0.476
TC (mmol/L)	4.54±0.26	4.17±0.53	3.91±0.58	0.476
HDL cholesterol (mmol/L)	1.26±0.13	1.27±0.15	1.28±0.15	0.832
LDL Cholesterol (mmol/L)	2.39±0.31	2.40±0.51	2.16±0.49	0.128
Triglycerides (mmol/L)	2.01±0.43	2.17±0.38	1.95±0.45	0.171
Mean viral load (copies/ml)	**< 50**	**50 - 1000**	**>1000**	**Anova P -value**
Sodium (mmol/L)	140.76±3.19	140.67±2.54	138.78±3.81	0.017*
Potassium(mmol/L)	3.54±0.34	3.66±0.36	3.56±0.33	0.360
Chloride(mmol/L)	104.53±3.40	104.87±3.25	106.12±4.32	0.214
Bicarbonate(mmol/L)	24.23±3.74	21.55±3. 58	22.95±3.70	0.911
Urea(mmol/L)	3.92±0.99	5.02±2.07	8.32±2.89	< 0.001*
Creatinine(µmol/L)	91.76±24.43	102.35±26.84	144.66±38.27	< 0.001*
FBG (mmol/L)	4.64±0.58	4.43±0.41	4.61±0.76	0.317
TC (mmol/L)	3.78±0.82	3.92±0.48	4.26±0.50	0.003*
HDL cholesterol (mmol/L)	1.31±0.17	1.27±0.14	1.27±0.13	0.613
LDL Cholesterol (mmol/L)	2.14±0.64	2.19±0.45	2.35±0.47	0.195
Triglyceride (mmol/L)	1.73±0.50	2.04±0.42	2.09±0.41	0.032*

FBG = Fasting Blood Glucose, PCV = Packed Cell Volume, TC = Total Cholesterol, LDL Low Density Lipoprotein, HDL = High Density Lipoprotein, CD4 = Cluster of Differentiation, , * = Significant at Fisher Exact P = value < 0.05

Table 2: Electrocardiographic findings of the studied pati

PARAMETERS	FREQUENCY
RHYTHM	
Sinus rhythm	68(68.0%)
Sinus tachycardia	27(27%)
Atrial fibrillation	5(5.0%)
Atrial flutter	0(0.0%)
A-V block	
No A-V block	94(94.0%)
First degree AV block	6(6.0%)
Second degree AV block	0(0.0%)
Third degree AV block	0(0.0%)
NSIVCD	
NSIVCD present	27(27.0%)
NSIVCD absent	73(73.0%)
BBB	
No BBB	70(70.0%)
LBBB	3(3.0%)
RBBB	7(7.0%)
LAH	9(9.0%)
LPH	11(11.0%)
PVCs	
No PVCs	70(70.0%)
Unifocal PVCs	16(16.0%)
Multi focal PVCs	14(14.0%)
QTc	
Normal	82(82.0%)
Prolonged	18(18.0%
ST-SEGMENT	
Normal	92(92.0%)
Depressed	8(8.0%)
Elevated	0(0.0%)
T-WAVE	
Normal	79(79.0%)
Flattened	6(6.0%)
Inverted	15(15.0%)
VH	
No LVH	100(100.0%)
LVH present	0(0.0%

A-V= Atrioventricular, NSIVCD = Nonspecific intraventri conduction defect, BBB = Bundle branch block, LBBB = bundle branch block, RBBB = Right bundle branch block, LPH = Left posterior hemi block, LAH= Left anterior hemi block, QTc = Corrected QT intervals, PVCs = Premature ventri contractions, LAD = Left axis deviation, RAD = Right deviation, LVH = Left Ventricular Hypertrophy * = Significa Fisher Exact P = value < 0.0

Table 3 : Electrocardiographic findings according to CD4 cells count

CD4 cells count cells/ µL	**<200 (N=12)**	**200-499 (N=30)**	**≥ 500 (N=58)**	**P-value**
Rhythm				
Sinus rhythm	1(8.3%)	9(30.0%)	58(100.0%)	
Sinus Tachycardia	6(50.0%)	21(70.0%)	0(0.0%)	
Atrial Fibrillation	5(41.7%)	0(0.0%)	0(0.0%)	
Atrial flutter	0(0.0%)	0(0.0%)	0(0.0%)	< 0.01 *
A-V Block				
No A-V block	6(50.0%)	30(100.0%)	58(100.0%)	
1st degree A -V block	6(50.0%)	0(0.0%)	0(0.0%)	
2nd degree A -V block	0(0.0%)	0(0.0%)	0(0.0%)	
3rd degree A -V block	0(0.0%)	0(0.0%)	0(0.0%)	
NSIVCD				
NSIVCD present	12(100.0%)	15(50.0%)	0(0.0%)	
NSIVCD absent	0(0.0%)	15(50.0%)	58(100.0%)	< 0.01 *
BBB				
No BBB	1(8.3%)	11(36.7%)	58(100.0%)	
LBBB	0(0.0%)	3(10.0%)	0(0.0%)	
RBBB	2(16.7%)	5(16.7%)	0(0.0%)	
LPH	5(41.7%)	6(20.0%)	0(0.0%)	
LAH	4(33.3%)	5(16.7%)	0(0.0%)	< 0.01 *
PVCs				
No PVCs	0(0.0%)	12(40.0%)	58(100.0%)	
Unifocal PVCs	6(50.0%)	10(33.3%)	0(0.0%)	
Multifocal PVCs	6(50.0%)	8(26.7%)	0(0.0%)	< 0.01 *
QTc				
Prolonged QTc	12(100.0%)	6(20.0%)	0(0.0%)	
Normal QTc	0(0.0%)	24(80.0%0	58(100.0%)	< 0.01 *
ST-Segment				
Normal ST -segment	9(75.0%)	25(83.3%)	58(100.0%)	
ST-segment elevation	0(0.0%)	0(0.0%)	0(0.0%)	
S- segment depression	3(25.0%)	5(16.7%)	0(0.0%)	< 0.01 *
T-Wave				
Normal T -wave	5(41.7%)	16(53.3%)	58(100.0%)	
Flattened T -wave	1(8.3%)	5(16.7%)	0(0.0%)	
Inverted T -wave	6(50.0%)	9(30.0%)	0(0.0%)	< 0.01 *

A-V= Atrioventricular, NSIVCD = Nonspecific intraventricular conduction defect, BBB = Bundle branch block, LBBB = Left bundle branch block, RBBB = Right bundle branch block, LPH = Left posterior hemiblock, LAH= Left anterior hemiblock, OTc = Corrected QT intervals, PVCs = Premature ventricular contractions, LAD = Left axis deviation, RAD = Right axis deviation, * = Significant at Fisher Exact P = value < 0.0

Table 4 : Electrocardiographic findings according to viral load distribution

Viral load (copies/ml)	< 50 (N=13)	50-1000 (N=40)	> 1000 (N=47)	P-value
Rhythm				
Sinus rhythm	13(100.0%)	40(100.0%)	15(31.9%)	
Sinus Tachycardia	0(0.0%)	0(0.0%)	27(57.4)	
Atrial Fibrillation	0(0.0%)	0(0.0%)	5(10.6%)	
Atrial flutter	0(0.0%)	0(0.0%)	0(0.0%)	< 0.01 *
A-V Block				
No A-V block	13(100.0%)	40(100.0%)	41(87.2%)	
1st degree A-V block	0(0.0%)	0(0.0%)	6(12.8%)	
2nd degree A-V block	0(0.0%)	0(0.0%)	0(0.0%)	
3rd degree A-V block	0(0.0%)	0(0.0%)	0(0.0%)	
NSIVCD				
NSIVCD present	0(0.0%)	0(0.0%)	27(57.4%)	
NSIVCD absent	13(100.0%)	40(100.0%)	20(42.6%)	< 0.01 *
BBB				
No BBB	13(100.0%)	40(100.0%)	17(36.2)	
LBBB	0(0.0%)	0(0.0%)	3(6.4%)	
RBBB	0(0.0%)	0(0.0%)	7(14.9%)	
LPH	0(0.0%)	0(0.0%)	11(23.4%)	
LAH	0(0.0%)	0(0.0%)	9(19.1%)	< 0.01 *
PVCs				
No PVCs	13(100.0%)	40(100.0%)	17(36.2 %)	
Unifocal PVCs	0(0.0%)	0(0.0%)	16(34.0%)	
Multifocal PVCs	0(0.0%)	0(0.0%)	14(29.8 %)	< 0.01 *
QTc				
Prolonged QTc	0(0.0%)	0(0.0%)	18(38.3%)	
Normal QTc	13(100.0%)	40(100.0%)	29(61.7%)	< 0.01 *
ST-Segment				
Normal ST segment	13(100.0%)	40(100.0%)	39(83.0%)	
ST segment elevation	0(0.0%)	0(0.0%)	0(0.0%)	
ST segment depression	0(0.0%)	0(0.0%)	8(17.0%)	
T-Wave				
Normal T-wave	13(100.0%)	40(100.0%)	26(55.3%)	
Flattened T-wave	0(0.0%)	0(0.0%)	6(12.8%)	
Inverted T-wave	0(0.0%)	0(0.0%)	15(31.9%)	< 0.01 *

A-V= Atrioventricular, NSIVCD = Nonspecific intraventricular conduction defect, BBB = Bundle branch block, LBBB = Left bundle branch block, RBBB = Right bundle branch block, LPH = Left posterior hemiblock, LAH= Left anterior hemiblock, OTc = Corrected QT intervals, PVCs = Premature ventricular contractions, LAD = Left axis deviation, RAD = Right axis deviation, * = Significant at Fisher Exact P = value < 0.05