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Original article

Incidence and CT Findings of Cerebrovascular Diseases among HIV Infected Adults in Correlation with CD4 Counts, in the Kingdom of Eswatini

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Abstract

Background: Due to the success of antiretroviral therapy (ART), the life expectancy among HIV-infected individuals has increased and AIDS-related causes of death. With the aging of the HIV-infected population, non-AIDS conditions such as cardiovascular disease (CVD) now account for substantial mortality and morbidity. **This study aimed to** assess the incidence and CT findings of cerebrovascular diseases among HIV infected adults in correlation with CD4 counts, in the Kingdom of Eswatini. **Methods:** This prospective study was conducted on 50 patients with HIV infected adults admitted to Mbabane National Hospital. Full history taking, full clinical examination, laboratory investigations (including CD4 + cell count, PCR detection of HIV RNA level. **Results**: There were 12 (24%) patients who were pre-ART, and 38 (76%) patients were on ART. All are seropositive, CD4+level in patients pre-ART ranged from 19 to 157% with a mean of 85.1 ± 40.89%, CD4+level in patients on ART ranged from 35 to 642 % with a mean of 347.22 ± 191.005 %. There was a significant positive correlation between CD4+ and Hb (r=0.722, P<0.001), Hct (r=0.719, P<0.001), total leukocyte count (r=0.756, P<0.001). There was a significant negative correlation between CD4+ and NIHSS (r= - 0.299, P=0.034), and cerebrovascular events (r= -0.774, P<0.001). **Conclusion:** The incidence of cerebrovascular events among HIV infected adults was 82% of patients (63% had ischemic stroke, 15% had others, and 22% had intracerebral hemorrhage). There was a significant positive correlation between CD4 cell count and Hb, Hct, and TLC. There was a significant positive correlation between HIV RNA Copies and cerbrovasular events. There was a significant negative correlation between CD4+ and NIHSS, and cerebrovascular events.

Keywords: Incidence; CT Findings; Cerebrovascular Diseases; HIV; CD4 Counts.

Introduction

Due to the success of antiretroviral therapy (ART), the life expectancy among HIV- infected individuals has increased and AIDS-related causes of death, namely opportunistic infections (OI) and AIDS-defining cancers, have become less common. With the aging of the HIV-infected population, non-AIDS conditions such as cardiovascular disease (CVD) now account for substantial mortality and morbidity (1).

Multiple factors may contribute to a high CVD risk among HIV-infected persons. Among HIV-infected persons, the vasculature may be damaged by HIV itself through both generalized inflammation as well as by direct infection and activation of T cells and macrophages in the vascular lining. Moreover, among HIV infected adults in the Eswatini, there is a high prevalence of traditional CVD risk factors such as smoking, hypertension and dyslipidemia. While MI has been the major outcome of interest in the field of HIV and CVD, cerebrovascular disease has remained considerably understudied (2).
In the setting of HIV infection, cerebrovascular events (CVE) (including ischemic strokes, hemorrhagic strokes, and transient ischemic attacks) have diverse etiologies. In the pre-ART era, strokes related to central nervous system (CNS) opportunistic infections made the independent association of HIV infection and CVEs difficult to establish. As the incidence of CNS opportunistic infections decreased with ART, CVEs were expected to become less frequent (3).

Furthermore, in contrast to CVD, the heterogeneity of stroke renders it more challenging to rigorously evaluate cerebrovascular risk factors in HIV infection; especially as careful validation of each outcome is required. So, it's important to examine the relationship between CD4 cell counts and validated ischemic stroke outcomes (4).

Frequently, these patients undergo urgent cranial CT to exclude pathologic abnormality. Although several studies have addressed the timing and appropriateness of CT in selected groups of patients, few studies have examined HIV-positive patients for clinical variables that might be predictive of those patients who would most benefit from CT. Because of the value of CD4 counts in predicting the relative risk of developing opportunistic infections and neoplasms, we assessed the diagnostic yield of screening CT of the head in HIV-positive patients as sorted by CD4 count (5).

The purpose of this study was to assess the incidence and CT findings of cerebrovascular diseases among HIV infected adults in correlation with CD4 counts and show the need of further imaging studies to enhance the medical

service provided in the Kingdom of Eswatini.

Patients and methods

This prospective study included 50 patients with HIV infected adults, admitted to Mbabane National Hospital (Kingdom of Eswatini) over a period of 3 months starting from approval of the institutional ethical committee.

An informed written consent was obtained from the patients or first of kin. Every candidate received an explanation of the purpose of the study and had a secret code number. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, Benha University (Ms.24-4-2024) and Mbabane National Hospital (FWA00026665/IRB00011253/SHR079/2024)from June 2024 to September 2024.

Inclusion criteria were patients >18 years, both sexes, and had HIV infection.

Exclusion criteria were patients with altered mental status, meningeal signs, with any infection rather than HIV, and patients' refusal.

All studied cases were subjected to the following: Full history taking, including Personal history: demographics and lifestyle factors. Present history: Onset, course and duration of symptoms, character of symptoms, location, radiation and severity of symptoms, any other symptoms that occur with the main complaint. Past history of HIV infection, CVD, neurological disorders, other medical conditions, surgeries, allergies and medications). Family history of CVD and other relevant conditions. **Risk factors:** Hyperlipidemia, smoking, obesity, post covid, past DVT, cancer on chemotherapy, recent operation, TB and family history stroke. **Full clinical examination** Complete general examination including vital signs, chest, cardiac, lower limbs and upper limbs and local examination by inspection, palpation and auscultation. **Laboratory investigations** Complete Blood Count (CBC), serum creatinine and blood urea nitrogen (BUN), electrolyte panel: - sodium, potassium, chloride, and bicarbonate, fasting Glucose and HbA1c, CD4 + cell count, HIV RNA level, liver function tests, including Serum Glutamic Oxaloacetic, transaminase (SGOT) and Serum Glutamic Pyruvic, transaminase (SGPT)].

PCR detection of HIV:

For detecting HIV in research patients, two methods were employed. The first method, the ELFA Test (BioMerieux - HIV duo), detects HIV-1 p24 and antibodies against HIV-1 and HIV-2. The second method, ELISA (NeoDin™), identifies antibodies for both HIV-1 and HIV-2. The sample used was 10 ml of whole blood collected in a vacutainer tube with EDTA as an anticoagulant. RNA was isolated from plasma using the Purescript RNA Isolation Kit (Gentra Systems), which involves salt

precipitation and alcohol precipitation to isolate RNA. The RNA yield was verified on a 1.5% agarose gel. HIV detection was performed with qualitative RT-PCR using the NeoDin kit. The kit included components for reverse transcription and amplification: RT-PCR mix (dNTPs, 10X reaction buffer, DTT, primers, and deionized water), RT-Enzyme 1 (reverse transcriptase), RT-Enzyme 2 (polymerase), and PCR mix for nested PCR (dNTPs, 10X reaction buffer, primers, cresol red, glycerol, and deionized water). Additionally, PCR Enzyme, positive control, and mineral oil were used, with dUTP and uracil N-glycosylase added. The RT-PCR method transcribes HIV RNA into complementary DNA (cDNA) and amplifies it under specific conditions. Reverse transcription involved 3 minutes at 57°C, 30 minutes at 42°C, and 3 minutes at 95°C. Amplification was conducted with 35 cycles of 30 seconds at 94°C, 30 seconds at 58°C, and 30 seconds at 72°C, followed by 5 minutes at 72°C. Nested PCR conditions included 5 minutes at 95°C, 30 cycles of 30 seconds at 94°C, 30 seconds at 68°C, and 30 seconds at 72°C, with a final 5 minutes at 72°C. PCR products were separated using 1.5% agarose gel electrophoresis, with bands visualized using a UV transilluminator. A positive result was indicated by a 210 bp band.

CD4 + cell count measurement:

The enumeration of CD4 lymphocytes numbers was carried out by SP flow cytometry (Trucount) on a FACS Calibur flow cytometer (BD Biosciences, San Jose, CA USA). Trucount tube containing twenty microliter (20 µL) monoclonal antibodies, fifty microliter (50 µL) well-mixed whole blood and four hundred and fifty microliter (450 µL) of FACS lysing solution was pipetted, capped, vortexed and incubated 15 minutes for analysis. The CD4 T cell was computed on the flow cytometer by the Multi set software (BD Biosciences) using the formula: CD4 T cell= sample bead count/50 and result of each patient were recorded to obtain absolute count.

HIV-RNA level (Viral Load):

HIV RNA levels were measured in plasma prepared from blood that had been collected in k3 EDTA containing tube and stored at -70˚C.HIV viral RNA levels in patient's plasma were detected by q-PCR Rotor gene using Qaigen kit.

CT scan:

CT was performed using a section thickness of 10 mm. Contrast material was IV administered after an initial review of the CT scans by an attending or resident radiologist. Scans were judged as yielding either negative or positive findings. Criteria for a positive scan included either intra-axial or extra-axial intracranial findings not interpreted as chronic based on either CT appearance or persistence on previous scans and extracranial pathologic findings, such as sinusitis, that could contribute to headache. For example, by these criteria, a well-defined lucency in a vascular distribution accompanied by

dilation of the adjacent ventricle or cerebrospinal fluid space would be interpreted as chronic, even in the absence of a previous CT scan. Normal scans or scans with insignificant or noncontributory findings were considered negative for the purposes of this study. Positive scans were then sub-grouped into the following categories: areas of hypodensity, hemorrhagic areas, pathologic enhancement, or atrophy disproportionate with patient age.

Approval code: Ms.24-4-2024

Cases presentation

case (1):

A 58 y old female, with past history of cancer cx , sero positive ,sero +ve ,Viral load 415 copies/ml, CD4 count 212,presenting with left sided hemiplegia, aphasia,. R/O CVA. The CT findings revealed Rt parieto-occipital ill-defined hypodense area is seen having a cortical and subcortical distribution with effacement of the overlying cortical sulci, Effacement of Rt lateral ventricle. Conclusion: Right parieto-occipital acute non hemorrhagic infarction**. Figure 1**

Case (2):

A 45 y old male, presenting with acute loss of consciousness, smoker and alcohol abuser, serologically positive, ART failure, Viral loud 3305 copies/ml, CD4 count 45. R/O CVA. The CT findings revealed Rt thalamic hyperdense area with perilesional edema, changed configuration of the Rt Lateral ventricle and intra ventricular hyper density. Conclusion: Right thalamic hemorrhagic infarction with intra ventricular extension. **Figure 2**

Statistical analysis

Statistical analysis was done by SPSS v28 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage (%). Pearson or spearman correlation was done to estimate the degree of correlation between two quantitative variables.

Results

Table 1 shows the baseline characteristics and comorbidities of the studied patients. Regarding the clinical symptoms, there were 29 (58%) patients presented with Unilateral hemiparesis, 3 (6%) patients presented with Unilateral tremors, 17 (34%) patients presented with Headache, 8 (16%) patients presented with Loss of consciousness, 10 (20%) patients presented with skin lesions and 1 (2%) patient presented with vision problems, Among the studied patients, there were 4 (8%) patients with hepatitis B coinfection and 11 (22%) patients with Hepatitis C coinfection those have been excluded from the study.

The laboratory findings of the studied patients are demonstrated in **Table 2**.

There were 38(76%) patients who were pre-ART and 12(24%) patients were on ART. All are seropositive, CD4+level in patients pre-ART ranged from 19 to 157% with a mean of 85.1

± 40.89%, CD4+level in patients on ART ranged from 35 to 642 % with a mean of 347.22 ± 191.005 %, Regarding most recent HIV RNA there were 38 (76%) patient had most recent HIV RNA>350 copies/mL. **Table 3**

The incidence rate of cerebrovascular events was 41 (82%); 26 (63%) patients had ischemic stroke, 6 (15%) patients had others, and 9 (22%) patients had intracerebral hemorrhage. The NIHSS score ranged from 2 to 15 with a mean 8.5 ± 4.55.**Table 4**

There was a significant positive correlation between CD4+ and Hb (r=0.722, P<0.001), Hct (r=0.719, P<0.001), total leukocyte count (r=0.756, P<0.001). There was significant positive correlation between Viral Load and cerebrovascular events (r=0.746, P<0.001). There was a significant negative correlation between CD4+ and NIHSS (r= -0.299, P=0.034), and cerebrovascular events (r= -0.774, P<0.001). There was an insignificant correlation between CD4+ and the other parameters. **Table 5**

Table 1: Baseline characteristics, Comorbidities, Clinical symptoms & Hepatitis B and C coinfection of the studied patients

		Total (n=50)
Age (years)	**Mean± SD**	34.32 ±8.53
	Range	20-50
Sex	**Male**	36 (72 %)
	Female	14 (28 %)
Weight (kg)	**Mean± SD**	76.3 ± 10.15
	Range	60 - 94
Height (m)	**Mean± SD**	1.7 ± 0.05
	Range	1.59 - 1.75
BMI (kg/m^2)	**Mean± SD**	27.4 ± 4.24
	Range	21.01 - 35.82
Residence	**Urban**	29 (58%)
	Rural	21 (42%)
Comorbidities	**Post covid**	27 (54%)
	Past DVT	35 (70%)
	Cancer on chemotherapy	27 (54%)
	Recent operation	16 (32%)
	Tb	10(20%)
	Hyperlipidemia	23 (46%)
	Smoking	6 (12%)
	Obesity	15 (30%)
	Family history stroke	14 (28%)
Clinical symptoms	**Unilateral hemiparesis**	29 (58%)
	Unilateral tremors	21 (42%)
	Headache	7 (14%)
	Loss of consciousness	8 (16%)
	Skin lesions	10 (20%)
	Vision problems	1 (2%)
Hepatitis B and C coinfection	**Hepatitis B coinfection**	4 (8%)
	Hepatitis C coinfection	11 (22%)

BMI: body mass index, DVT: Deep vein thrombosis, TB: tuberculosis.

Table 2: Laboratory investigation of the studied patients

		Total (n=50)
Hb (g/dl)	**Mean± SD**	10.39± 2.24
	Range	7.5-15.2
RBCs (*10^{12}/L)	**Mean± SD**	3.5 ± 1.62
	Range	1.02 - 6.3
Hct (%)	**Mean± SD**	43.2 ± 10.8
	Range	30 - 65
PLT (*10^{9}/L)	**Mean± SD**	229.9 ± 63.62
	Range	151 - 340
Total leukocyte count (cells/mm^3)	**Mean± SD**	3973.2 ± 1741.9
	Range	1494 - 6484
HBA1c (%)	**Mean± SD**	5.96 ± 1.59
	Range	2.4 - 8.5
FBG (mg/dL)	**Mean± SD**	168.4 ± 55.66
	Range	70 - 240
SGOT (U/L)	**Mean± SD**	42.6 ± 22.61
	Range	20 - 90
SGPT (U/L)	**Mean± SD**	42.5 ± 19.77
	Range	20 - 89
Serum creatinine (mg/dL)	**Mean± SD**	
	Range	1.33 ± 0.35
Urea (mg/dL)	**Mean± SD**	0.8 - 1.8
	Range	44.1 ± 13.83
Na (mEq/L)	**Mean± SD**	20 - 68
	Range	148.06 ± 6.99
K (mEq/L)	**Mean± SD**	135 - 160
	Range	4.4 ± 0.62
CL (mEq/L)	**Mean± SD**	3.5 - 5.5
	Range	101.2 ± 9.06
HCO_3 (mEq/L)	**Mean± SD**	87 - 115
	Range	24.5 ± 2.1

PLT: platelet count, RBCs: red blood cells, Hct: hematocrit, FBG: fasting blood glucose, SGOT: serum glutamic oxaloacetic transaminase, SGPT: serum glutamic pyruvic transaminase.

Table 3: ART and CD4+level in patient's pre and on ART and the most recent HIVRNA of the studied patients

		Total (n=50)
Patients pre-ART		38(76%)
Patients on ART		12(24%)
CD4+ (%) pre-ART	**Mean± SD**	85.1 ± 40.89
	Range	19-157
CD4+ (%) on ART	**Mean± SD**	347.22 ± 191.005
	Range	35 - 642
Most recent HIVRNA>400 copies/mL	**Yes**	38 (76%)
	No	12 (24%)

CD4+: cluster of differentiation 4, ART: antiretroviral therapy.

Table

Table 4: Incidence and CT findings of cerebrovascular diseases and NIHSS score of the studied patients

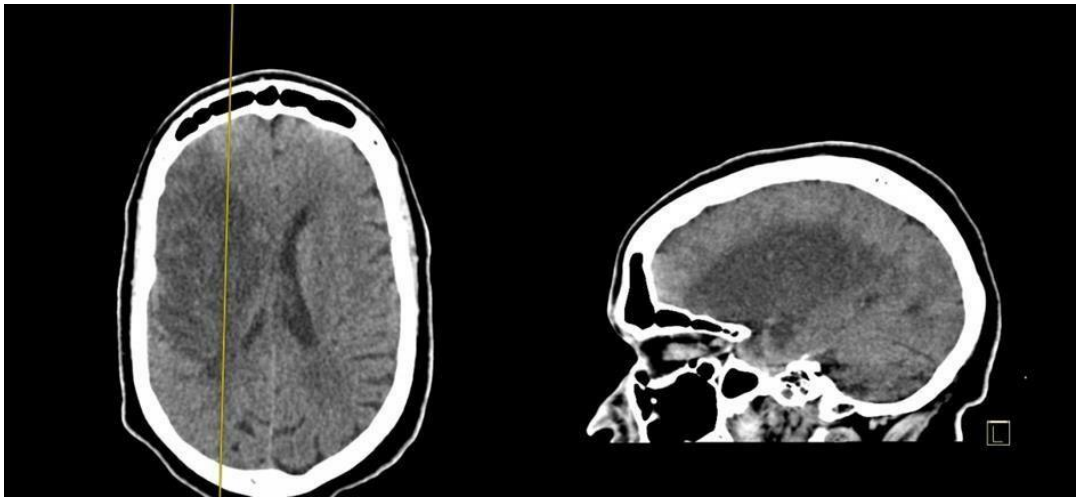
		Total (n=50)
Incidence of cerebrovascular event	**Yes**	41)82%)
	No	9(18%)
Type of event	**Ischemic stroke**	19 (38%)
	Intracerebral haemorrhage	4 (8%)
	Others	5 (10%)
NIHSS score	**Mean± SD**	8.5 ± 4.55
	Range	2 - 15

NIHSS: The national institutes of health stroke scale.

Table 5: Correlation between CD4+/viral load and other parameters and other parameters

	r	P
Age (years)	0.236	0.099
Sex	-0.053	0.713
HTN	0.017	0.907
DM	-0.146	0.312
CKD	-0.083	0.569
HF	-0.04	0.783
Smoking	-0.12	0.406
Obesity	-0.116	0.423
Stroke	0.012	0.932
Hb (g/dl)	0.722	**<0.001***
RBCs (*10^{12}/L)	-0.256	0.073
Hct (%)	0.719	**<0.001***
Total leukocyte count (cells/mm^3)	0.756	**<0.001***
HBA1c (%)	0.029	0.841
SGOT (U/L)	0.144	0.319
SGPT (U/L)	0.174	0.227
Serum creatinine (mg/dL)	0.064	0.660
Urea (mg/dL)	-0.123	0.395
Na (mEq/L)	ئ-0.088	0.546
K (mEq/L)	-0.136	0.346
CL (mEq/L)	0.184	0.202
HCO_3 (mEq/L)	0.124	0.392
NIHSS	-0.299	**0.034***
Cerebrovascular events	-0.774	**<0.001***

HTN: Hypertension, DM: diabetes mellites, PLT: platelet count, RBCs: red blood cells, Hct: hematocrit, FBG: fasting blood glucose, SGOT: serum glutamic oxaloacetic transaminase, SGPT: serum glutamic pyruvic transaminase, r: correlation coefficient, *: statistically significant as p value <0.05.



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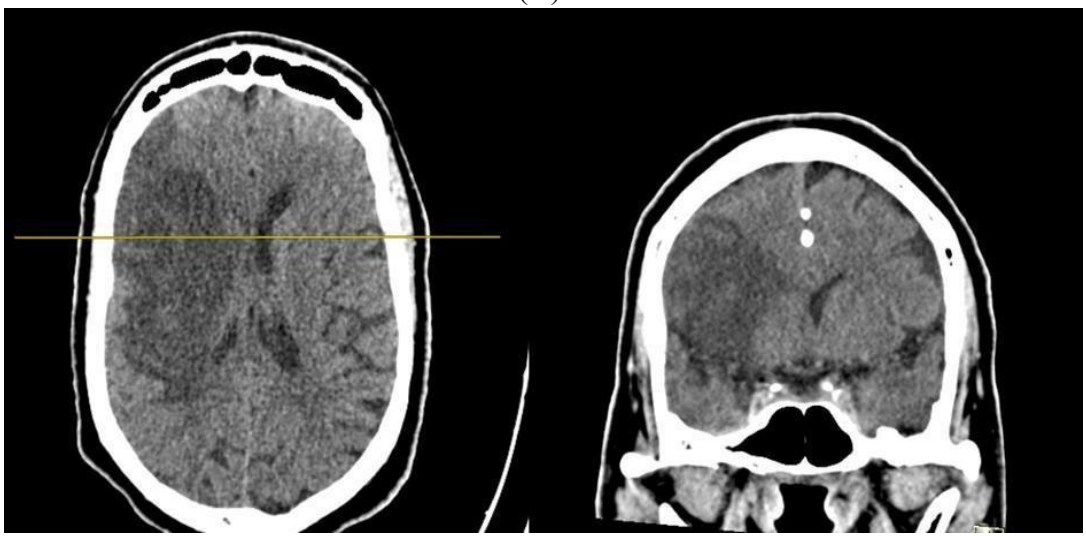
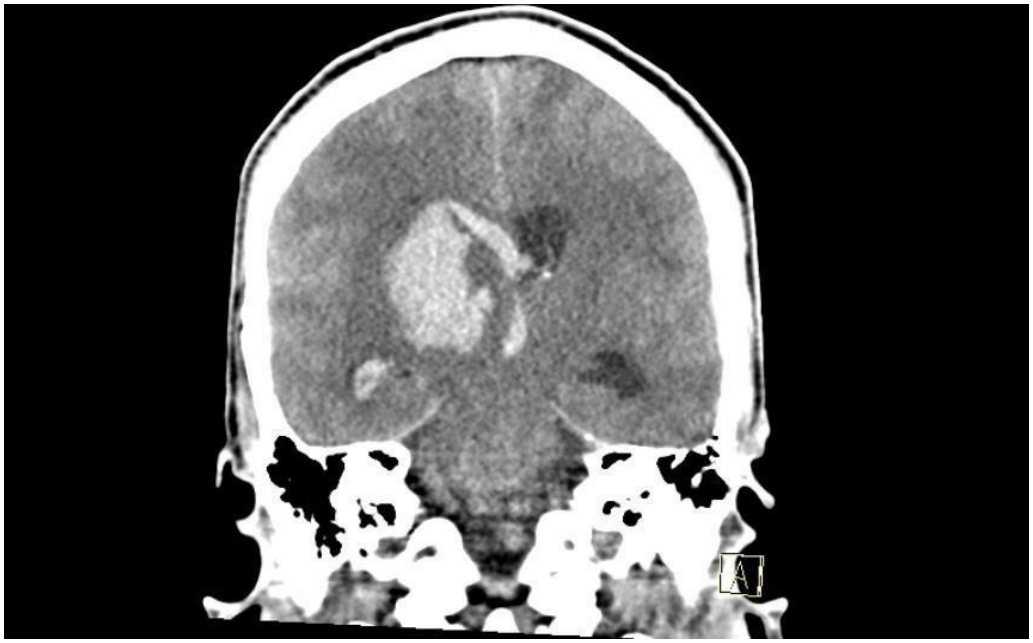
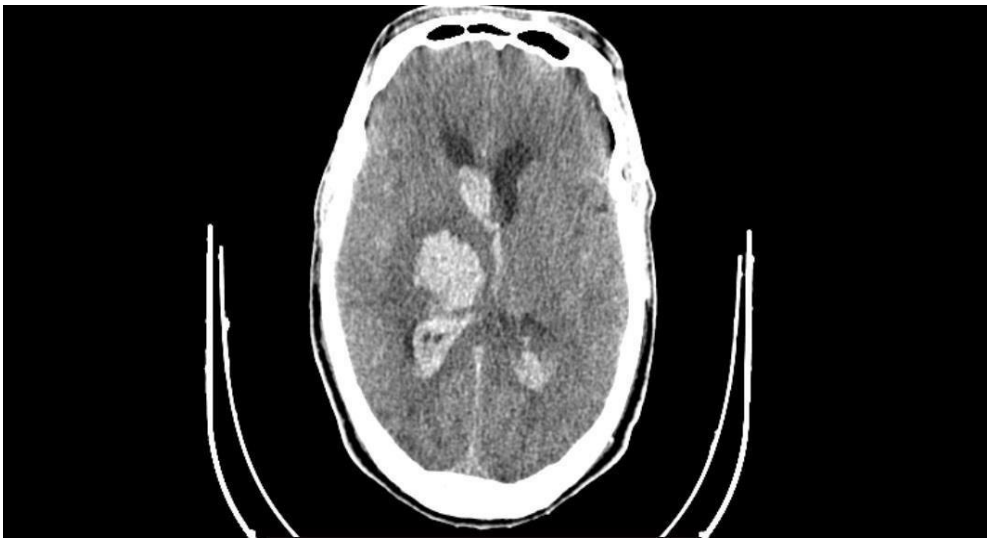


(B)

Figure 1: A: Rt parieto-occipital ill-defined hypodense area, B: Rt parieto-occipital ill-defined hypodense area • Effacement of Rt lateral ventricle



(A)



(B)

Figure 2: A: Rt Thalamic hyper density, B: Rt thalamic hyperdense area • changed configuration of the Rt Lateral ventricle and hyper density in lateral ventricle

Discussion

Neurological complications of HIV infection are common since HIV can cross the blood- brain barrier early, thus entering the nervous system at all levels of the neuraxis (brain, meninges, spinal cord, nerve, and muscle). However, subsequent neurological syndromes and their frequency, timing, and pathobiology are still not clear. The frequency of neurological complications varies according to the stage of the disease (6).

In our study, regarding the baseline characteristics, the age of the studied patients ranged from 20 to 50 years

with a mean of 34.32 ±8.53 years. There were 36 (72 %) males and 14 (28 %) females. The weight of the studied patients ranged from 60 to 94 kg with a mean of 76.3 ± 10.15 kg. The height ranged from 1.59 - 1.75 m with a mean of 1.7 ± 0.05
m. The BMI ranged from 21.01-35.82 kg/m2 with a mean of 27.4 ± 4.24 kg/m2.There were 29 (58%) patients from urban area and 21(42%) patients from rural area.

In accordance with our findings, Hudson et al. (7) conducted forty-five studies including 5218 people living with HIV (mean age, 48.5 years) and 2414 uninfected individuals (mean age, 49.1 years) were identified. Women contributed to 24% of the HIV study population. The mean age of people living with HIV ranged from 22 to 63 years; in 23 studies (51%), the mean age was greater than 50 years. Study populations had high rates of current smoking with 26 studies (58%) reporting a prevalence of more than 30% among people living with HIV.

In the current study, regarding the comorbidities, 2 (4%) patients were post COVID, 3 (6%) patients were post DVT, 2 (4%) patients had cancer on chemotherapy, 6 (12%) patients had recent operation, 10(20%) patients had Tb, 23 (46%) patients had hyperlipidemia, 26 (52%) patients were smokers, 25 (50%) patients were obese, 14 (28%) patients had family history stroke and 3 (6%) patients had recent history of Road traffic accident.

In parallel with us, Murray et al. (8) reported that 101 patients had diabetes type II and 101 had hypertension.

In the present study, there were 29 (58%) patients presented with unilateral hemiparesis, 21 (42%) patients presented with unilateral tremors, 7 (14%) patients presented with headache, 8 (16%) patients presented with loss of consciousness, 10 (20%) patients presented with skin lesions and 1 (2%) patient presented with vision problems.

In same line with our findings, **Izbudak et al.** (9) studied the presentation in 8 HIV- infected patients. The first case presented with mild Lt Face, leg, and arm weakness, dysarthria, and transient loss of vision at the first presentation and loss of consciousness at the late presentation. The second case presented with Rt facial, Lt upper and lower extremity weakness, and dysarthria at the first presentation and Rt sided residual weakness at the late presentation. The third case presented with Rt upper limp hemiparesis and tremors, facial droop and gate disturbance at the first presentation and Rt sided hemiparesis and residual gate disturbance the last presentation. The fourth case presented with Rt arm and leg weakness and transient imbalance at the first presentation and Rt hand choreiform movements at the last presentation. The fifth case presented with a history of acute loss of consciousness post covid infection at the first presentation and hemiplegia at the last presentation. The sixth case presented with memory loss, confusion, dysarthria, stumbling gait; muscle weakness in hands, thighs, and hips at the first presentation and decreased mental status and dementia at the last presentation. The seventh case presented with Headache, transient imbalance and dysarthria at the first presentation and confusion, blurry vision, photophobia at the last presentation. The eighth case was

presented with acute loss of consciousness at the first presentation that deteriorated and passed away. The ninth case presented after recent cesarean section with Lt sided hemiplegia, aphasia that both almost completely improved after receiving medication. The tenth case presented with progressive headache after initiation of chemotherapy for cancer cervix and consumption of traditional medicine then developed rt sided hemiplegia that progressed to loss of consciousness, convulsions finally passed away

According to our study, among the studied patients, there were 4 patients with hepatitis B coinfection and 11 patients with hepatitis C coinfection all of them have been excluded from the study.
In agreement with us, Vinikoor et al. (10) showed that there were 119 (4.7%) patients with hepatitis B coinfection and 405 (16%) patients with hepatitis C coinfection.

Regarding the present study, 38(76%) patients were pre-ART, and 12(24%) patients were on ART. All are seropositive. CD4+ ranged from 19 to 157 % with a mean of 85.1 ± 40.89% in patients pre-ART. CD4+ ranged from 35 to 642 % with a mean of 347.22 ± 191.005 % in patients on ART. There were 38 (76%) patients had most recent HIV RNA>350 copies/mL.

In accordance with our findings, Hudson et al. (7) revealed that the majority of people living with HIV (88%) were taking ART. In their study (67%)of involved participants with a mean CD4 cell count of more than 500 cells/µL.

According to our results, the incidence rate of cerebrovascular events (CVEs) was 41 (82%); 26 (63%) patients had ischemic stroke, 6 (15%) patients had others like mixed pathologies, intracranial infections, and 9 (22%) patients had intracranial hemorrhage. The NIHSS score ranged from 2 to 15 with a mean 8.5 ± 4.55.

In accordance with us, Edwards et al. (11) showed that of 144 patients, 55 patients (38.2%) had radiographic evidence of cerebral vasculopathy. Twenty (13.9%) had a vasculopathy characterized by vessel dolichoectasia and intracranial aneurysm formation. Thirty-five patients (24.3%) had intra- and or extracranial stenosis/occlusion. The mean peak viral load in patients with normal vessels was 126,114 copies/mL in contrast to 317,161 copies/mL in those with vessel dolichoectasia and/or aneurysms. In comparison to our study only 1 patient suggested to have radiological evidence of cerebral vasculopathy.

In the current study, there was a significant positive correlation between CD4+ and Hb (r=0.722, P<0.001), Hct (r=0.719, P<0.001), and TLC (r=0.756, P<0.001). There was a significant positive correlation between Viral Load and cerebrovascular events (r=0.746, P<0.001).There was a significant negative correlation between CD4+ and NIHSS (r= -0.299, P=0.034), and cerebrovascular events (r= -0.774, P<0.001). There was an insignificant correlation between CD4+ and the other parameters.

In agreement with our findings, Sakai et al. (12) discussed how pattern recognition approaches can contribute to their early differentiation. In

patients with CD4 count of <200 cells/mm3, there is a higher risk of HIV-related CNS diseases including HIV encephalopathy, OIs, and primary CNS lymphoma (PCNSL).

In contrast with us, Arentzen et al. (13) studied 19 HIV-infected patients with a CVE and revealed that the median CD4+ cell count in the present study was >350/µl (25th to 75th percentile: 251–568) at the time of the event. The good immune status is the result of regular and long-term cART application. This is important since in past studies CVE in HIV-infected patients had primarily correlated with a poor immune status which generally promotes the manifestation of opportunistic infections and tumors.

Conclusion

Our study revealed that the increased incidence of cerebrovascular events among HIV infected adults with Higher HIVRNA copies and Lower CD4 cell count, 82% of patients (63% had ischemic stroke, 15% had others, and 22% had intracerebral hemorrhage). There was a significant positive correlation between CD4+ and Hb, Hct, and TLC. There was a significant positive correlation between HIV RNA copies /ml and cerebrovascular events. There was a significant negative correlation between CD4+ and NIHSS, and cerebrovascular events.

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