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Original Research Article

Current Situation in India for Central Nervous System Imaging Findings in HIV/AIDS

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Abstract

Background: India has the second-highest burden of HIV-related pathology after Sub-Saharan Africa. One of the primary targets of the neurotropic human immunodeficiency virus is the central nervous system (HIV). Despite the fact that there have been many in-depth research on the subject, HIV and AIDS are still prevalent.

Aims & objectives: This study was started to determine the current state and range of neurological diseases associated with HIV/AIDS and to clarify how magnetic resonance imaging (MRI) helps to characterize and distinguish disorders of the central nervous system.

Materials and Methods: This cross-sectional descriptive study was conducted in city of Dahod, Gujarat , India, at a Tertiary Care Diagnostic Centre affiliated with the Department of Radiodiagnosis of Zydus Medical College & Hospital, Dahod, Gujarat ,India . MRI was performed on 120 seropositive individuals who had neurological complaints, and the imaging results were examined.

Results: 51.6% of the participants in our study were over 40, making up the age group with the highest prevalence. More men (65%) than women (35%) were impacted. Opportunistic infections were found in 60% of cases, while HIV-induced primary neurological disease was observed in 25% of cases. Tuberculosis was the most prevalent opportunistic infection in HIV, followed by PML (22%), toxoplasmosis (14%), and fungi (6%). In 5% of instances, primary CNS lymphoma was discovered. Fever (41.6%) and altered sensorium (33.3%) were the two most frequent presenting symptoms at the time of admission. In our investigation, TB was the most frequent cause of meningitis. The most frequent causes of infarction (focal neurological impairment) were thought to be HIV vasculopathy and tubercular meningitis.

Conclusion: We got to the conclusion that Tuberculosis is still the most common CNS pathology found in HIV/AIDS in India. In the absence of any contraindications, MRI should be thought of as one of the first lines of investigations in a seropositive patient with neurological complaints. MRI is an excellent way to detect and characterize brain lesions in AIDS.

Keywords: Acquired Immunodeficiency Syndrome, HIV, MRI, Opportunistic infections, CNS Tuberculosis, Toxoplasmosis, Primary CNS Lymphoma, PML

Introduction

The neurotropic human immunodeficiency virus (HIV) breaches the blood–brain barrier early in the course of the illness [1]. As a result, HIV primarily targets the central nervous system (CNS), with roughly two-thirds of patients experiencing CNS involvement over the course of their illness. Neurological disease is the earliest manifestation of the symptomatic HIV infection in around 10-20% of patients [2].

The primary consequences of HIV, opportunistic infections, neoplasms, and vascular disorders make up the majority of the pathology impacting the Central Nervous System (CNS) in people with HIV illness [3]. Clinical findings due to lack specificity are frequently useless for differentiating between the wide varieties of neurological disease processes associated with AIDS. The majority of cases of HIV-related neurologic illnesses in nations with widespread HAART usage include cognitive impairment and peripheral neuropathies brought on by HIV, but in other nations, opportunistic infections of the CNS are more prevalent [4-7]. A side effect of HAART known as immune reconstitution inflammatory syndrome (IRIS) results in the temporary exacerbation or emergence of new signs, symptoms, or radiological evidence of opportunistic infection following the start of treatment. IRIS can occasionally result in a deadly outcome [8]. IRIS is hypothesized to result from an immune response that has been restored and it affects the imaging results. India, behind only Sub-Saharan Africa, has the second-highest burden of HIV-related pathology, primarily brought on by HIV-1 class C in both geographical regions, as opposed to the United States and Europe [9].

Opportunistic infections of the central nervous system (CNS) are the primary cause of reported neurological morbidity and mortality in AIDS in underdeveloped nations like India. Imaging modalities, particularly Magnetic Resonance Imaging (MRI), play a crucial role in the diagnosis and follow-up of AIDS patients with neurological problems, despite the fact that the imaging characteristics of several CNS illnesses exhibit a significant amount of overlap [10-13]. The central nervous system can be affected by lesions, and magnetic resonance imaging is very sensitive to these lesions. It is highly helpful in making the final diagnosis of the central nervous system abnormalities when combined with the findings of other testing [14]. Modern methods have been employed to increase the sensitivity for identifying the type, viability, and load of the disease as well as the host tissue response, such as MR spectroscopy (MRS) and MR perfusion studies [15].

Materials and Methods

Study design: Cross sectional descriptive study.
Study site: Tertiary care Diagnostic centre.
Study Timeline: Around 1.4 years from November 2020 to March 2022
Sample size: 120

Sampling method: Random

Inclusion criteria: All patients with neurological symptoms who had their HIV status confirmed by ELISA/western blotting and were willing to provide written informed consent to participate in the trial. The institutional ethical committee gave its approval to the current study.

Exclusion criteria: Patients with contrast media allergies, those with MRI contraindications, and those who were unwilling to participate in the study were excluded.

Study methodology and tools employed: Magnetic resonance imaging was performed on all of the patients who met the inclusion requirements. On a GE 1.5

Tesla MR system, MR imaging tests were conducted. Slices had a 0.5 mm interslice gap and a thickness of 4-5 mm.

The following sequences were obtained:
Pre-contrast

- Axial and coronal T1 weighted images
- Axial and sagittal T2 weighted images
- Axial fluid-attenuated inversion recovery (FLAIR)
- Diffusion weighted imaging (DWI)
- Susceptibility weighted imaging/ gradient recalled echo (SWI/GRE)

Post contrast

- T1 weighted fat suppressed images.
- MP RAGE(3D T1 gradient echo sequence), Axial fluid-attenuated inversion recovery (FLAIR)

Additionally, MR-Spectroscopy, MR-Perfusionstudy, MR-Angiography/ venography were done whenever required.

Contrast Administration: Intravenous Gadolinium DTPA was delivered in accordance with the indicated dose, i.e. 0.1 mmol/kg or 0.2 ml/kg, following adequate consent, history & patient education.

Data evaluation: The final diagnosis was made after evaluating clinical symptoms, laboratory studies, and radiographic results. Values and percentages served as representations for quantitative data. Additionally, Qualitative data were displayed using visuals like pie charts & bar graphs.

Observation and Results : In our study of 120 patients in total, 40 (33.3%) were in the age range of 41 to 50 years, followed by the age range of 31 to 40 years, which contained 36 (30%). Least number of patients were 4 in the age categories of 11-20 years and more than 60 years. More men (65%) than women (35%) were impacted. Ratio of male to female was 1.86:1.

Fever was the most frequent clinical manifestation, found in 41.6% of patients overall, followed by altered sensorium (33.3%), headache (26.6%), stroke (26.6%), and dementia (20%).

60% (72/120) of the patients had the most frequently observed condition, opportunistic infections. In 25% (30/120) of patients, early HIV symptoms like brain shrinkage and HIV encephalopathy were present.

A total of 5% (6/120) of the patients had CNS lymphoma. 18.3% (22/120) of the patients displayed infarcts due to cerebrovascular problems. In 5% (6/120) of patients, further abnormalities such arachnoiditis and Pott's spine with para-vertebral abscesses were discovered.

Table 1: Diagnosis and frequency of CNS pathologies in HIV patients

Sr. No	Pathologies	No. of patients	% age
1.	**Primary effects** of HIV	**30**	25 %
	Cortical Atrophy	12	
	HIV encephalopathy	18	
2.	**Opportunistic Infections**	72	60 %
	CNS Tuberculosis	**42**	
	Toxoplasmosis	10	
	Fungal Infections	04	
	PML	16	
3.	Lymphoma	06	5 %
4.	**Cerebrovascular** complications	**22**	18.3 %
	Infarction	22	
	Haemorrhage	00	
5.	Any other	**06**	5 %
	Arachnoiditis	02	
	Pott’s spine	04	

38% (16/42) of the CNS tuberculosis patients in our study had isolated tuberculous meningitis. Equal numbers of individuals had isolated tuberculomas, but 9.5% (4/42) of them also had tuberculous meningitis. 14.3% (06/42) of the cases (tubercular abscess) were seen. 38% of the patients, or 16 out of 42, developed communicating hydrocephalus. There were vascular infarcts in 28.3% (10/42) of the cases. 14.2% (06/42) of the patients had additional findings such arachnoiditis (2/42) and Pott's spine (4/42).

Table 2: Spectrum of Neurotuberculosis in HIV patients (n =42)

Imaging Diagnosis	Number of patients	% age
Tuberculoma	16	38.0 %
Tubercular meningitis	16	38.0 %
Tuberculomas with tubercular meningitis	04	9.5 %
Tubercular abscess	06	14.3 %
Total	**42**	

Patchy diffusion restriction was present in 2 cases. There was no bulk impact or enhancement in any of the lesions. Associated cerebral atrophy and ventricular prominence were seen in 75% (12/16) patients.

There are 6 CNS lymphoma cases in our analysis. Multiple lesions were present in every patient. 4 of these 6 occurrences included the supratentorium (periventricular and subcortical white matter). On T1W images, each lesion was isointense. On T2W images, 2 cases had hypo- to isointense lesions, whereas the others had hyper-intense lesions. Each case had homogeneous, ring pattern, and heterogeneous enhancement, with varying enhancement patterns being seen. While two cases displayed mass effect, four cases displayed surrounding edema. On a perfusion study, 66.6% (04/06) of the cases displayed hyper perfusion.

HIV encephalopathy affected a total of 18 people. In all 18 (100%) of the patients, there were bilateral symmetrical lesions. In 16 cases (88%), periventricular lesions were found. They didn't all exhibit contrast enhancement. In 8 (44.5%) of the patients, associated cerebral cortical atrophy was present. 20 patients out of 120 had meningitis, or 6%. Meningitis in every case was linked to CNS tuberculosis. Aseptic meningitis and meningitis brought on by other opportunistic illnesses were not encountered. 22 patients in our study, or 18.3%, displayed imaging characteristics that suggested an infarct. Ten patients experienced infarction as a result of TB infection. Another 10 patients' infarct etiologies were unclear, although they did not have any other risk factors including smoking, hypertension, diabetes, or hyperlipidemia. Presumptive diagnosis of HIV Vasculopathy was taken into consideration in this particular cohort in the absence of clear etiological variables and after ruling out other predisposing factors to CV stroke.

Table 3: Correlation between CD4 Count and Neurological manifestations

CD4 Level	TB	Cryptococcosis	Toxoplasmosis	PML	HIV Encephalopathy	Lymphoma
0-50	00	02	02	02	00	02
51-100	02	00	04	04	00	02
101-150	06	00	04	06	02	02
151-200	02	00	00	00	00	00
201-250	10	00	00	04	02	00
>250	22	00	00	00	14	00
Total	42	02	10	16	18	06

In our study, 25.0% of cases had CD4 counts between 210 and 205, 37.8% had CD4 counts between 101 and 150, and 37.8% had CD4 counts under 100. Patients with toxoplasmosis had CD4 counts below 100 and no cases had CD4 values greater than 250.60%. No patient had a CD4 count more than 150. CD4 counts in 2 cases of cryptococcosis were less than 50. All six lymphoma cases—one each in CD4 counts of 0–50, 51–100, and 101–150—had CD4 counts below 150. Maximum 52.4% (22/42) of patients with CNS tuberculosis had CD4 levels above 250. Similar to this, 14/18, or 77.7% of patients with HIV encephalopathy, had CD4 counts above 250.

Discussion

In this cross-sectional descriptive study, 120 seropositive patients who presented with neurological complaints underwent MRIs, and the imaging results were analyzed. It was conducted in the Department of Radiodiagnosis at a Tertiary Diagnsotic centre at Dahod, Gujarat , India affiliated with Zydus Medical College & Hospital, Dahod, Gujarat. The age group between 21 and 40 years old accounted for 45% of the study population, making it the second most prevalent age group behind those over 40. Males were more frequently impacted than females.

In patients with neurological involvement, the male: female ratio is 1.86:1. Fever (41.6%) was the most frequent presenting symptom at the time of admission, followed by altered sensorium (33.3%), headache and stroke in 26.6% of patients each, dementia (20%), convulsions (6.6%), and vomiting in 6% of cases. Opportunistic infections were found in 60% of cases, while HIV-induced primary neurological disease was observed in 25% of cases. Most prevalent opportunistic infection in HIV was Tuberculosis which was present in 58.3% (42/72) cases followed by PML 22%, Toxoplasmosis 14 % and fungal infections 6%. Out of a total of 120 patients, only 2 had cryptococcosis. In 5% of instances, primary CNS lymphoma was discovered. Our study revealed a higher percentage of CNS manifestations caused by HIV's primary side effects, including HIV-associated dementia and Progressive Multifocal leukoencephalopathy, compared to earlier Indian studies conducted by HM Rana et al. in 2011 and Sharma SR et al., S Pawar et al., and S Pawar et al. in 2017(PML). Neurotuberculosis involvement was virtually equal [9-14].

In our investigation, there were fewer instances of fungus diseases [16-18]. There were no Neurosyphilis cases found. Our investigation revealed reduced occurrences of toxoplasmosis and fungal infections and greater incidences of

neurotuberculosis when compared to non-Indian studies by Sokolska et al. and Berhe et al. The percentage of dementia caused by HIV, however, is quite comparable. In our analysis, CNS tuberculosis accounted for 35.0% of all pathologies, or 42/120 cases. Twenty (47.5%) of the 42 CNS TB patients showed cisternal/meningeal elevation. Twenty patients (47.6%) had tuberculomas with enhancing parenchymal lesions, and six (14.7%) had tubercular abscesses. In 16 (38%) of the 42 cases, communicating hydrocephalus was present [19-21]. There were vascular infarcts in 10 (23.8%) patients.

In a few cases, it was also noted that further discoveries of arachnoiditis (2/42) and tubercular spondylodiscitis with paravertebral abscesses (4/42) had been made. The range of CNS TB found in HIV patients in our study is comparable to findings from other earlier investigations, including those by Sarosh et al. and Michelle Whiteman et al [24]. The imaging results in our study's cases of toxoplasmosis, progressive multifocal leukoencephalopathy, CNS lymphoma, HIV encephalopathy, and fungi were consistent with those from earlier research by Miguel J et al., Enting et al., Mark et al., Johnson et al., keerati hongsakul et al., and M. Judith Donovan[22-26]. 20 patients out of 120 had meningitis, or 6%. Meningitis in every case was linked to CNS tuberculosis. Aseptic meningitis and meningitis brought on by other opportunistic illnesses were not encountered.

22 patients in our study, or 18.3%, displayed imaging characteristics that suggested an infarct. Ten patients experienced infarction as a result of TB infection. Another 10 patients' infarct etiologies were unclear, although they did not have any other risk factors including smoking, hypertension, diabetes, or hyperlipidemia. Presumptive diagnosis of HIV Vasculopathy was taken into consideration in this particular cohort in the absence of clear etiological variables and after ruling out other predisposing factors to CV stroke [27-29]. However, it was not completely excluded that infarcts could have developed as a result of other infections such CMV, varicella-zoster virus, a previous subclinical CNS infection, or a fungal infection. Vasculopathy in HIV-positive people has a complex pathogenesis that has been the subject of much discussion. Practically speaking, HIV vasculopathy can be categorized as vasculitis caused by HIV. On MR angiography, 2 patients of subacute infarct had minor abnormality of the ipsilateral MCA. When the history was probed further, the patient admitted to a history of hypertension and continuous smoking. Our study is comparable to research by Brent Tipping, Alaka Deshpande, and M.D. Connor, among others. [27-29]

Summary and Conclusion

The most frequent CNS pathology associated with HIV/AIDS in India is still tuberculosis, despite an increase in the number of cases with HIV-induced primary neurological disease. Different brain disorders' imaging findings may overlap, however specific imaging traits and the location of the lesions may favor a particular diagnosis. However, in addition to imaging, correlation with clinical history and other laboratory parameters are very important. In the absence of any contraindications, MRI should be thought of as one of the first lines of investigations in a seropositive patient with neurological complaints. MRI is an excellent way to detect and characterize brain lesions in AIDS.

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