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Brain MRI In HIV And Associated Diseases In Patients Attending RIMSH- A Case Series

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Abstract: *About 20.4 lakh adults in India live with Human immunodeficiency virus(HIV) infection, according to the National AIDS Control Society,2017. Mizoram, Manipur, and Nagaland are the states with the highest prevalence of the disease.*

Central Nervous System (CNS) involvement in HIV could be due to direct invasion by the virus itself or by infected leucocytes. In addition to this, many opportunistic infections and certain tumors also affect the brain, which is normally prevented by a healthy immune system. Magnetic Resonance Imaging(MRI) has a unique advantage over other diagnostic methods as it is non-invasive, has an excellent contrast resolution, and can also accurately diagnose most of the diseases that affect the brain in an immunocompromised patient. Here we describe 5 representative cases of HIV and related diseases affecting the brain that came to the Radiodiagnosis Department, RIMS Hospital, Imphal.

Keywords*- AIDS, CNS lymphoma, CNS Tuberculosis, Cryptococcosis, HIV, MRI, opportunistic infections, PML, Toxoplasmosis.*

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I. Introduction

About 20.4 lakh adults in India live with Human immunodeficiency virus (HIV)/ Acquired Immune deficiency Syndrome (AIDS), according to the National AIDS Control Society, 2017. Mizoram, Manipur, and Nagaland are the states with the highest prevalence of the disease[1].

HIV can spread through infected body fluids, unprotected intercourse, or can have vertical transmission from an infected mother to her child.

CNS infections in people living with HIV –AIDS could be caused by a variety of pathogens, including the virus itself. Human Immunodeficiency Virus -1 is the most common pathogen in adults, and it also is the most common infection seen in the CNS. The most common opportunistic infection in HIV/AIDS is toxoplasmosis. In addition to infections, certain tumors like CNS – Lymphoma are also associated with this disease.

MRI has a unique advantage over other diagnostic methods as it is non-invasive, has an excellent contrast resolution, and can also accurately diagnose most of the diseases that affect the brain in an immunocompromised patient.

Here we describe 5 representative cases of HIV and related diseases affecting the brain that came to the Radiodiagnosis Department, RIMS Hospital, Imphal.

II. Aim

To demonstrate the importance of MR imaging as a modality to diagnose various diseases affecting the brain in HIV.

III. Methods

MR imaging of the brain with T1, T2, FLAIR, DWI, and gadolinium-enhanced T1 sequences are taken in each representative case of the most common diseases affecting CNS in HIV infected patients.

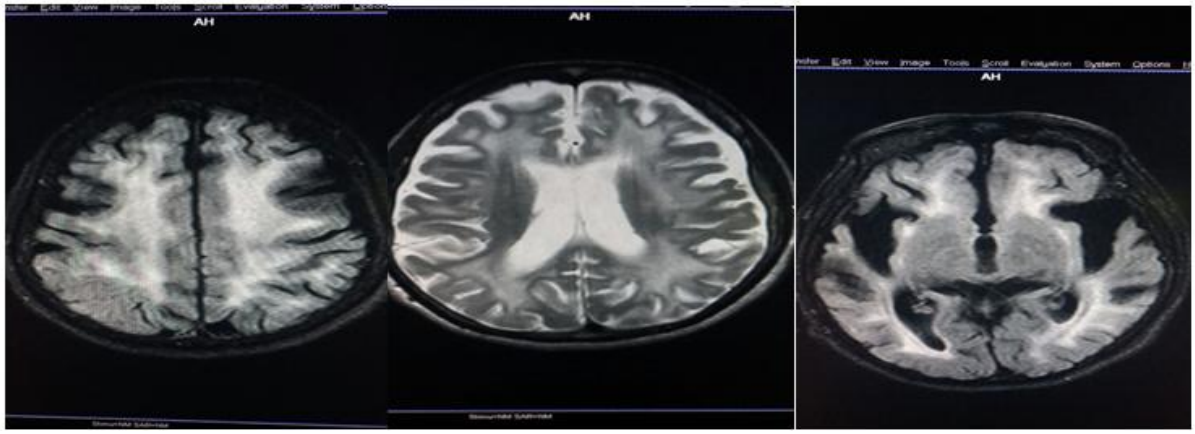
IV. Results

I.HIV Leukoencephalopathy

A 50-year-old woman came with dementia. She was diagnosed with HIV 15 years back and was taking antiretroviral treatment for 12 years, after which she was lost to follow up.

MRI brain was done, which showed cerebral atrophy that was disproportionate to the patient's age. Confluent T1 hypointense, T2 Hyperintense bilaterally symmetrical periventricular white matter changes are seen, which do not extend till the subcortical U fibers. The lesions showed no contrast enhancement or diffusion restriction. (FIG-1)

FIG-1



The patient was diagnosed with HIV leukoencephalopathy.

Discussion*:* HIV is a neurovirulent infection which can cause HIV encephalitis (HIVE) or HIV leukoencephalopathy (HIVL)[2]. The clinical manifestations can range from neurocognitive disorders to dementia. HIV encephalopathy is seen in 10-20% of cases of AIDS patients and increases with age[3].

On MRI, brain atrophy is seen on T1 weighted images with prominent sulci and ventricles. On T2/ FLAIR, hazy white matter hyperintensities are seen, which are bilaterally symmetrical but do not reach up to the subcortical region. No diffusion restriction is seen. Usually, T1 weighted Gadolinium-enhanced images do not show any enhancement, except possibly in cases of acute fulminant HIV-encephalitis[2]. However, normal brain MRI does not exclude HIV encephalitis.

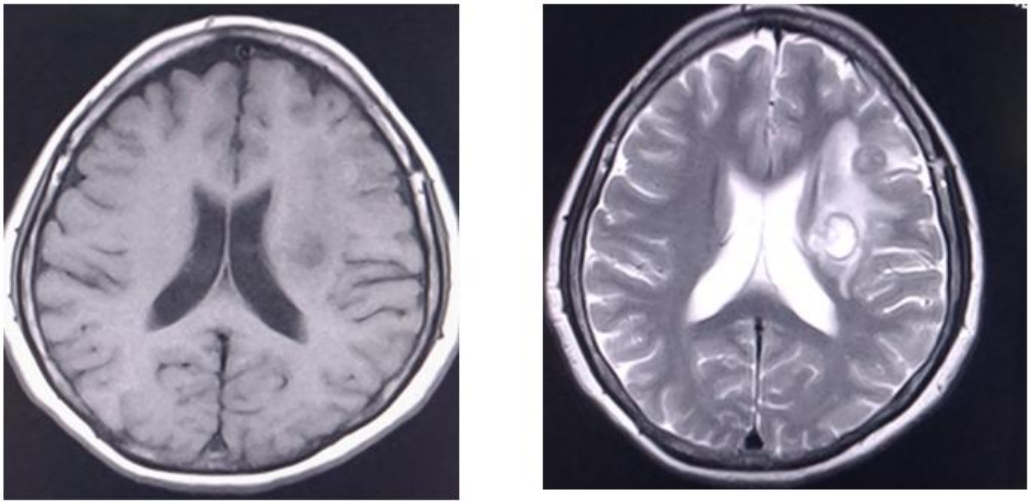
The main differential diagnosis includes progressive multifocal leukoencephalopathy.

II. CNS Toxoplasmosis

A 40-year-old woman on antiretroviral therapy for 8 years and a known case of pulmonary tuberculosis on antitubercular therapy came with mild right-sided hemiparesis.

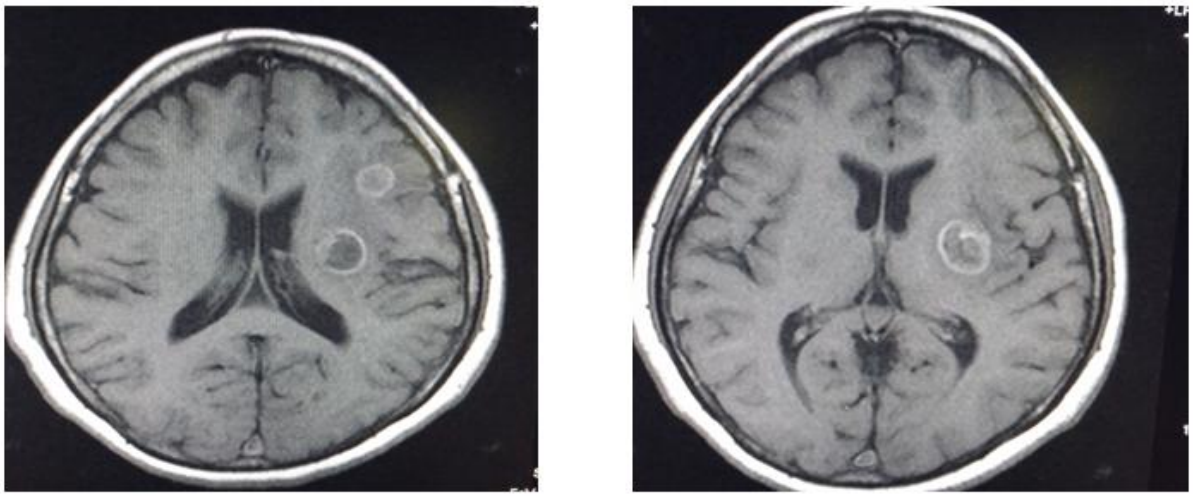
MRI brain was done, and multiple T1 hypointense lesions are seen at the left corona radiata, with a slight high signal is seen at the left frontal corticomedullary junction, appearing "onion ring" like on T2 with alternating hypo and hyperintensities with significant perilesional edema, better appreciated in the lesion at the corona radiata. (FIG-2)

FIG-2



On Contrast administration, ring-like enhancement is seen with an eccentric target-like appearance. (FIG-3)

FIG-3



Discussion*:* Toxoplasmosis is the most common opportunistic infection in HIV/AIDS, caused by reactivation of latent infection by Toxoplasma gondii.It is an obligate intracellular parasite with cats acting as the definitive host and many other mammals, including humans acting as the intermediate host.

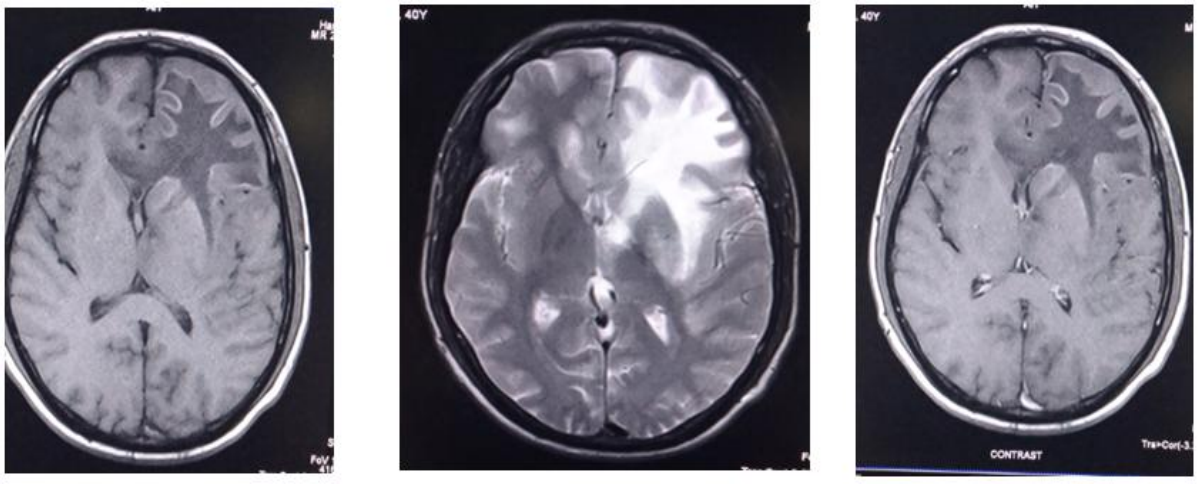
Typically, CNS toxoplasmosis is seen as multiple lesions, about 1-4 cms in diameter at the cortico-medullary junction and basal ganglia, although single lesions or lesions at the brain stem or cerebellum could also be seen[3]. T1WI shows a hypointense mass that occasionally demonstrates mild peripheral hyperintensity caused by coagulative necrosis or hemorrhage. Alternating concentric zones of hyperintensity (necrosis) and hypointensity with marked perilesional edema and demyelination are seen on T2WI. As a toxoplasma abscess organizes, intensity diminishes, and eventually, the lesion becomes isointense relative to white matter. One or more nodular and ring-enhancing masses are typical on T1 C+ caused by an inflamed vascular zone that borders the necrotic abscess cavity[2]. Contrast enhancement could be reduced or absent if the patient is severely immunocompromised[3].

III. Progressive multifocal leukoencephalopathy

A 50-year-old man came with dementia. He was diagnosed with HIV 20 years back and was taking antiretroviral treatment and discontinued after 5 years of diagnosis.

Bilaterally asymmetrical T1 hypointense, T2 hyperintense periventricular lesions were seen at the b/l frontoparietal lobes with extension till the subcortical U fibers showing no contrast enhancement or diffusion restriction, predominant on the left side (FIG-4).

FIG-4

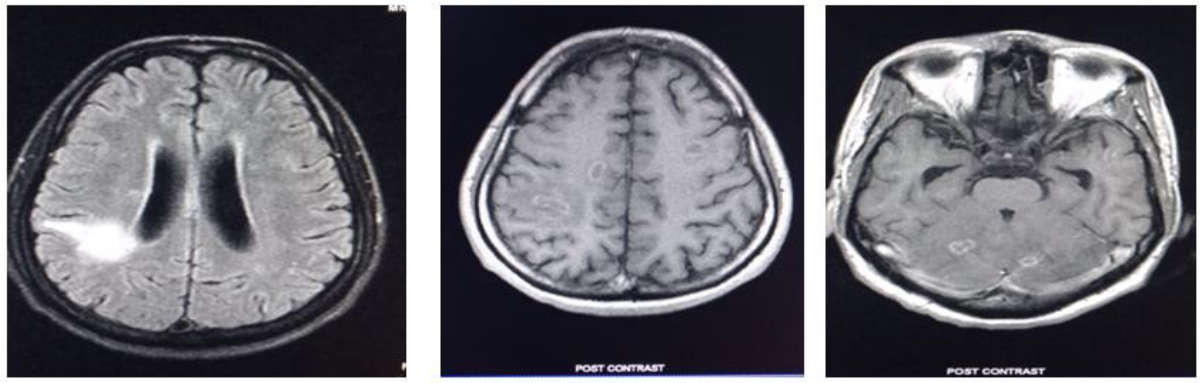


Discussion: Progressive multifocal leukoencephalopathy (PML) is an opportunistic infection caused by the JC virus (John Cunningham Virus) of papovaviridae family.
Three phases in the development of PML have been identified- clinically inapparent primary phase, latent infection in kidneys, bone marrow, and lymphoma tissue, and lastly, CNS infection after reactivation[2]. Reactivation is seen when the CD4 count drops to less than 100/mm3.
HIV is the most common cause of JC virus reactivation. Clinically, the patient presents with cognitive impairment, focal neural deficits, and seizures[3].
On MRI, the lesions are multifocal, asymmetric with ill-defined borders involving the subcortical and cerebellar white matter predominantly. These lesions appear isointense on T1, hyperintense on T2, and FLAIR, with no contrast enhancement. Diffusion-weighted imaging shows a characteristic peripheral superintendent rim, which corresponds to the front line of active demyelination[3].
Immune Reconstruction Inflammatory Response can also be associated with PML, wherein the patient deteriorates clinically as antiviral drugs restore the immunity. Imaging features include an increase in T2/FLAIR superintendent, contrast enhancement, and diffusion restriction. It has a good prognosis if the acute inflammatory response is brought under control[3].

IV. CNS Tuberculosis

A 40-year-old male, known case of HIV for 10 years on treatment with a history of pulmonary tuberculosis (TB) treated 2 years back, came with altered mental status to the emergency department.
MR imaging was done where multiple T1 hypointensities were seen, predominantly at the corticomedullary junction. Axial FLAIR image shows well defined hyperintense lesion at the right parietal lobe with extensive surrounding edema.
Multiple hypointense lesions on FLAIR with surrounding hyperintense edema can also be seen scattered in b/l cerebral hemispheres
C+T1 weighted images show multiple ring-enhancing lesions in b/l frontal and parietal lobes and cerebellum suggestive of tuberculomas
The right parietal lobe lesion shows ring enhancement with extensive surrounding edema s/o Tubercular pseudo abscess. (FIG-5)

FIG-5



Discussion: Mycobacterium tuberculosis is an atypical organism that evades acute inflammatory response by hiding intracellularly[4].Neurotuberculosis is secondary to hematogeneous spread from extracranial infection, most frequently in the lungs[2].
CNS TB begins with the development of small TB ("Rich") foci in the subpial or subependymal surfaces of the brain and spinal cord. Rupture of a Rich focus into the subarachnoid space causes meningitis, vasculitis, and occasionally encephalitis. Granulomas with caseating necrosis are typical of tuberculosis[4]. CNS TB can be classified into TB meningitis (TBM), Tuberculoma/ tubercular granuloma, and tubercular pseudo abscess, tubercular vasculopathy, and encephalopathy.
Tubercular meningitis is characterized by the presence of exudates predominantly in the basal cisterns and the Sylvian cisterns, which appear isointense on T1 weighted imaging[5]. FLAIR scans show increased signal intensity in the sulci and cisterns, giving a dirty CSF appearance. Marked linear or nodular meningeal enhancement is seen on T1 contrast-enhanced (C+) Fat Suppressed images.
Most TB granulomas are solid caseating, necrotizing lesions that appear hypo- or isointense with the brain on T1WI and hypointense on T2WI[2]. They show ring-like enhancement in T1 C+ images.
TB pseudo abscesses are so-called because they have necrotic rather than pustular content and are rare, usually found in immunocompromised patients. They are multiloculated, larger than granulomas (> 3 cm), and have

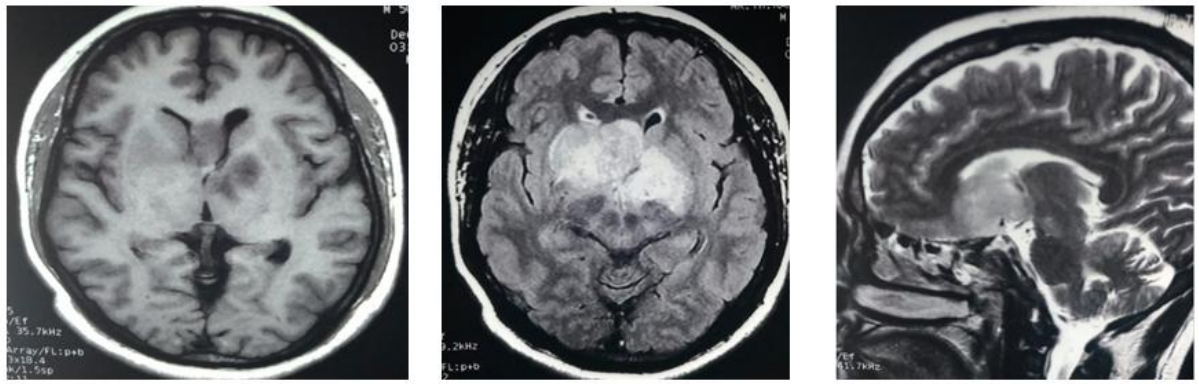
extensive perilesional edema. They also show ring like contrast enhancement. An important distinguishing feature of a pseudo abscess from a granuloma is its T2 hyperintensity due to the presence of necrotic content[2].
Tubercular encephalopathy is usually seen in younger patients and is characterized by diffuse brain edema and demyelination[6].

V. HIV associated lymphoma

A 60-year-old male, known case of HIV diagnosed 10 years back, came with episodes of seizure and altered mental status.

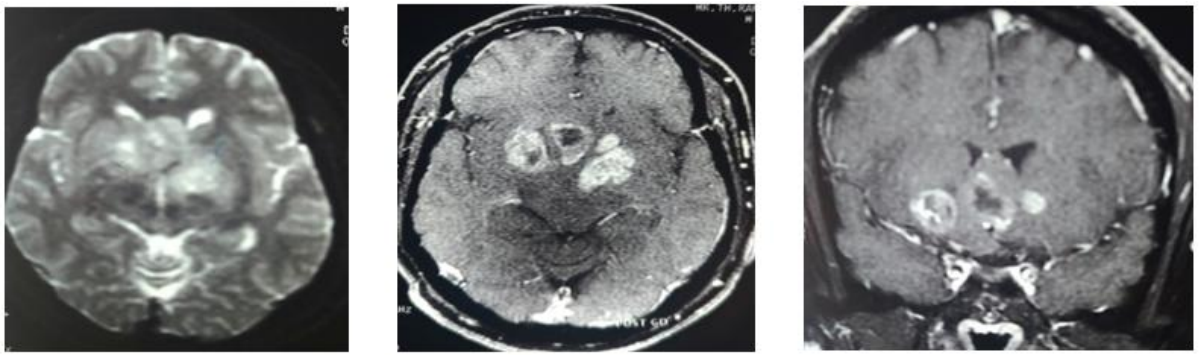
Multiple T1 hypointense and T2 heterogeneously hyperintense lesions are seen centered around the third ventricle, crossing the corpus callosum with mass effect on the b/l basal ganglia. These lesions show a heterogenous rim like enhancement. Diffusion restriction is seen on DWI images. (FIG-6)

FIG-6



Heterogenous enhancement with central non-enhancing areas suggesting necrosis is seen on contrast administration. Lymphoma often shows heterogeneous enhancement and necrosis in HIV patients(FIG-7)

FIG-7



Discussion: HIV associated Lymphoma is the second most common AIDS-defining Malignanciy(ADM)[7]. Most lymphomas in HIV are of the diffuse large B-cell Non-Hodgkin's lymphoma (NHL) type. HIV infected patients are 12 times more likely than non-HIV patients to develop NHL[7]. Usual Imaging features include solid masses centered around the third ventricle which show homogenous and intense contrast enhancement. As these tumors are highly cellular, they show diffusion restriction. However, atypical features are very common in HIV patients And include necrosis and hemorrhage, giving a heterogenous appearance.

The main differential diagnosis in this scenario is toxoplasmosis and glioblastoma. Toxoplasmosis usually is seen as multiple T2 hyperintense lesions that involve the grey-white matter junction and basal ganglia, showing ring-like contrast enhancement. Glioblastoma shows rCBV (relative cerebral blood volume) and ADC (apparent diffusion coefficient) values higher than that of primary CNS Lymphoma[8].

V. Conclusion

With the initiation of HAART(Highly Active Anti-Retroviral Therapy), AIDS-related deaths have dropped by over 5% in the last 5 years. But in developing countries, HIV incidence is raising especially in women and children. Many CNS infections in this setting are caused by organisms that are clinically inapparent in immunocompetent people. Most patients present with nonspecific CNS symptoms, which can have a variety

of causes. In some cases, imaging findings are diagnostic and no additional investigations are required. MRI plays a very important role in this scenario with its excellent soft-tissue spatial resolution and its ability to delineate the location and extent of involvement.

VI. Recommendations

This case series was performed on a 1 Tesla MRI. Newer machines with a higher power are available that can perform studies that are quick, easy, with newer features like MR Spectroscopy, 3D reconstruction, and with a better spatial resolution which can give better and more complete diagnoses.

Conflict of interest: Nil
Acknowledgments: Nil

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