



## MAGNETIC RESONANCE IMAGING EVALUATION OF CENTRAL NERVOUS SYSTEM MANIFESTATIONS IN PATIENTS INFECTED WITH HUMAN IMMUNODEFICIENCY VIRUS

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### ABSTRACT

**Aim :** 1. To study different MRI patterns of various CNS manifestations in HIV positive patients.  
2. To know the role of MRI in diagnosis of various neurological manifestations in HIV positive patients.

**Materials and Methods :** Retrospective observational study was carried out over a period of 15 months from August 2019 to October 2020 in the department of radio-diagnosis in S.V.P hospital, Ahmedabad with Siemens 3T Magnetom Skyra MRI machine on 30 patients.

**Results :** Our retrospective study suggested that out of 30 patients, 10 patients had TB, 8 had HIV Encephalitis, 7 had Progressive Multi-focal Leukoencephalopathy, 3 had toxoplasmosis, 1 case of lymphoma and cryptococcal infection each.

**Conclusion :** MRI due to its multi-planar capability and excellent soft tissue resolution played an important role in early as well as accurate diagnosis of various neurological manifestations of HIV infection which prompted early and appropriate treatment improving the prognosis of disease.

### KEYWORDS :

#### INTRODUCTION :

Human immunodeficiency virus (HIV), neurotropic virus enters the brain early after infecting humans and may remain in the central nervous system despite successful anti-retroviral treatment[2,4].

India has the third highest burden of HIV in the world with an estimated 23.49 lakhs people living with HIV in 2019[3].

The spectrum of CNS involvement in HIV includes effect of the virus itself, opportunistic infections, certain neoplasms and the effect of treatment. These patients show increased prevalence of certain opportunistic infections with CD4 + counts of less than 200 CD4 + T cells/ $\mu$ L[1,2].

MRI with its multi-planar capability and excellent resolution is the preferred modality of choice for imaging the brain. It helps in the diagnosis and to quantify the severity of brain injury. It is also used to monitor the treatment effects and to detect complications of the disease and the treatment.

#### MATERIALS AND METHODS :

A retrospective observational study was conducted in our hospital. The predominant CNS symptoms included headache, cognitive or behavioural disorder, seizures or motor deficits.

**Inclusion criteria:** Only HIV positive patients with positive CNS imaging findings were included in this study.

The predominant exclusion criteria were standard contraindications to MRI.

This study finally included 30 patients of HIV who had positive CNS imaging findings in initial MRI brain. MRI findings were correlated with laboratory results and HPE wherever possible.

#### IMAGING PARAMETERS :

All scans were performed on Siemens 3T Magnetom Skyra MRI machine. Standard sequences (T1WI, T2WI, FLAIR,

Gradient, DWI and post contrast T1WI) were obtained in axial, coronal and sagittal planes. Contrast agent used was Gadopentetate Dimeglumine (Magnilek).

Scan parameters:

Slice: 25 for axial plane, 35 to 50 for coronal plane and 21 to 25 for sagittal plane

Slice thickness : 4 mm

Field of view: 220-240

Distance factor: 10 (1 distance factor = 0.2 mm)

#### RESULTS :

Out of the 30 cases of HIV, mean age of the patients was 38 years (range 8-60 years). Out of total 30 patients, 26 patients had CD4 counts less than 200 CD4 + T cells/ $\mu$ L.

There were total 10 cases of TB in this study out of which 8 had tuberculomas (three solitary and five multiple). Out of the 5 having multiple lesions, 3 had conglomerated lesions. 6 had imaging findings of tubercular meningitis. 4 had imaging findings of hydrocephalus, 1 presented acute infarct in the basal ganglia.

A total of 8 cases were diagnosed with HIV encephalitis and 7 patients had imaging findings of PML.

There were 3 cases of toxoplasmosis. 2 patients had multiple lesions with bilateral distribution. There was 1 case of PCNSL and cryptococcal infection each.

**Table - 1: INCIDENCE OF DISEASES BASED ON FINAL DIAGNOSIS**

DISEASE	NO. OF PATIENTS	PERCENTAGE
TB	10	33.3%
HIVE	8	26.6%
PML	7	23.3%
TOXOPLASMOSIS	3	10%
PCNSL	1	3.3%
CRYPTOCOCCOSIS	1	3.3%

**Table - 2: COMMON FINDINGS IN CNS TB**

COMMON FINDINGS	NO. OF PATIENTS
TUBERCULOMA	8
TUBERCULAR MENINGITIS	6
HYDROCEPHALUS	4
ACUTE INFARCT	1

**DISCUSSION :**

HIV is the most powerful risk factor for reactivation of latent TB and in turn TB co-infection accelerates the progress of HIV infection. Common CNS manifestations of TB are tuberculomas, meningitis, hydrocephalus and acute infarct. The basal exudates appears hyperintense to CSF on T1WI, T2WI and FLAIR images with intense post contrast enhancement. Caseating tuberculomas shows hypointense rim and central hyperintensity on T2WI. All lesions in our study had perilesional oedema and mass effect and were distributed in the cortico-medullary junction, white matter and in the cerebellar hemisphere. Conglomerated lesions were seen as multiple coalescing tuberculomas. The lesions showed ring enhancement/nodular enhancement. On MRS, they show lipid lactate peak[2,6]. No case of tubercular abscess was present in our study.

HIV encephalitis and leucoencephalopathy (synonymous with AIDS dementia complex) are the result of direct effect of the HIV infection resulting in cognitive impairment[2,7,8]. Risk factors include increasing age, longer duration of HIV infection and low CD4 count cells. PML is an opportunistic infection caused by JC virus in patients with CD4 counts of 50–100 CD4+T cells/uL. It is characterised by brain atrophy disproportionate to the age and diffuse white matter demyelination. T2WI and FLAIR images initially show bilateral patchy white matter hyperintensities, which become diffusely confluent involving the subcortical and deep white matter. MRS shows decreased N Acetyl Aspartate (NAA) and increased choline (Cho). HIV encephalitis does not enhance or restrict, has no mass effect and spares the subcortical U fibres. These findings differentiate it from PML[2,9].

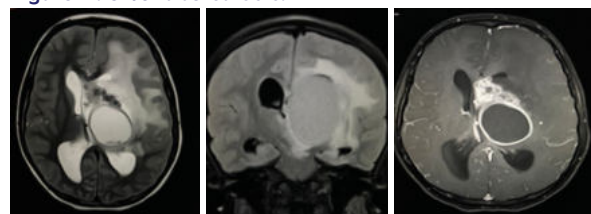
PML is an opportunistic infection caused by JC virus. The spectrum includes classic PML, inflammatory PML, JC encephalopathy, meningitis and infection of granular cell layer of cerebellum[2,10]. On MRI, the lesions appear hyperintense on T2WI and FLAIR, predominantly involving the subcortical and deep white matter with involvement of U fibres and sparing of cortex. Enhancement and mass effect is noted in inflammatory PML. MRS findings are non specific.

Toxoplasmosis caused by *Toxoplasma gondii* parasite, is the most common opportunistic infection and the main cause of a CNS mass lesion[2,7]. Multifocal lesions are common. The lesion mainly involves the cortico-medullary junction, periventricular region, basal ganglia and thalamus. The most common location was in the basal ganglia. On T1WI the lesions appear hypointense, while hyperintensity on T1WI, suggestive of haemorrhage differentiates it from untreated lesions of lymphoma. On T2WI, lesions show central hyperintensity (necrotising abscess) with a hypointense rim. Extensive perilesional oedema was seen in all acute cases. Most lesions showed nodular and ring enhancement. In addition, lesions may show an enhancing eccentric nodule, 'target sign', which is suggestive of toxoplasmosis. A close differential diagnosis is tuberculosis which can be ruled out by clinico-laboratorial correlation.

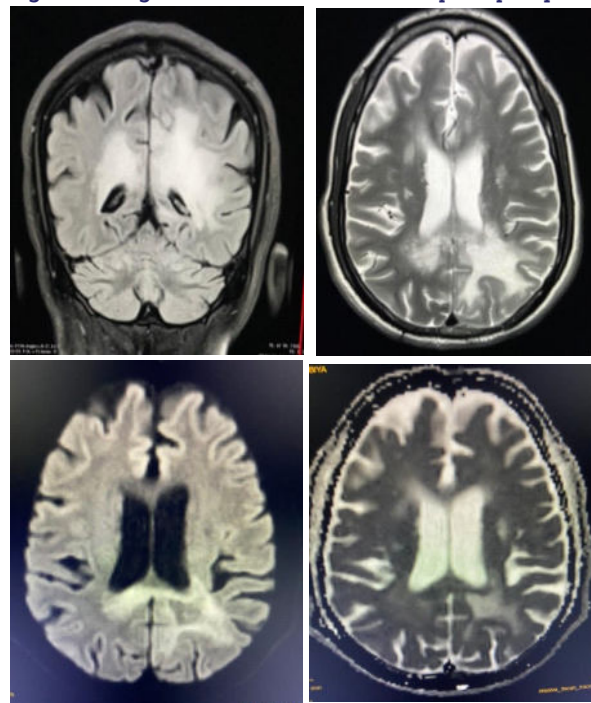
Primary CNS lymphomas are the second most common cause of a cerebral mass in a HIV patient. The lesion is usually solitary predominantly involving the periventricular white matter. The lesion appears isointense on T1WI and heterogeneously hyperintense on T2WI and shows heterogeneous post contrast enhancement. The lesion shows

significant mass effect. MRS showed increased Cho peak, reversed Cho/creatinine ratio, markedly decreased NAA[2,11,12]. The diagnosis of PCNSL in our study was later confirmed on brain biopsy. The main differential diagnosis of PCNSL was neurotoxoplasmosis. Features that favoured primary CNS lymphoma include single lesion, solid enhancement, no haemorrhage before treatment and on MRS: increased Cho. Features that favoured cerebral toxoplasmosis included multiple lesions, scattered throughout the cortico-medullary junction, basal ganglia and thalamus, ring or nodular enhancement, haemorrhage occasionally occurs mostly in periphery of lesion, and on MRS: decreased Cho.

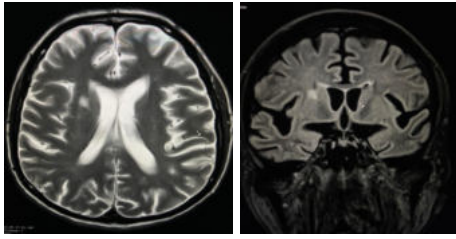
Cryptococcus is another common opportunistic infection caused by fungus *Cryptococcus neoformans* in patients with CD4 counts of 50 – 100 cells/ ul. It has 3 primary manifestations: meningitis, gelatinous pseudocysts and cryptococcomas where meningitis is the most common manifestation. Meningeal enhancement and hydrocephalus is seen in meningoencephalitis. Dilatation of perivascular spaces due to pseudocyst is a frequent finding. These pseudocysts follow CSF signal intensity. Cryptococcomas are uncommon, which presents as mass lesion.

**Figure- 1: CNS Tuberculosis.**

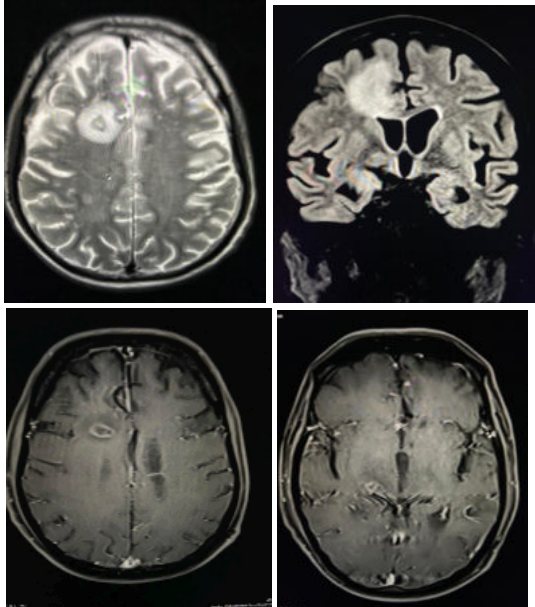
Multiple conglomerated ring enhancing altered signal intensity lesions with surrounding peri-lesional edema in left gangliocapsular and thalamo-capsular region with obstructive mild hydrocephalus.

**Figure- 2: Progressive Multifocal Leukoencephalopathy.**

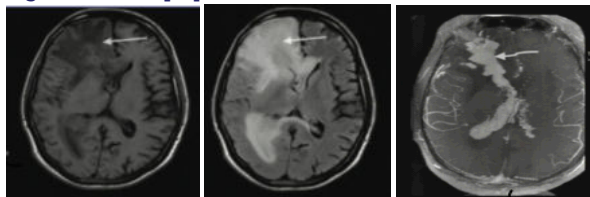
Asymmetrical T2WI/ FLAIR hyperintense areas involving U fibres in left parietal lobe, subcortical and deep white matter of bilateral parietal periventricular region and in splenium of corpus callosum on both sides showing diffusion restriction.

**Figure- 3: HIV Encephalitis**

Cerebral cortical atrophy disproportionate to the age and bilaterally symmetrical T2/ FLAIR hyperintensity in periventricular white matter of bilateral parieto-occipital lobe.

**Figure- 4: Toxoplasmosis.**

Multiple ring enhancing altered signal intensity lesions with perilesional edema at grey white matter junction and deep white matter of right frontal lobe and right thalamus.

**Figure- 5: CNS Lymphoma**

Well defined intra-axial lesion epicentered in deep white matter of right frontal lobe extending upto the meningeal surface which showed intense post contrast enhancement.

### CONCLUSION :

In the complex CNS manifestations of HIV and AIDS patients, neurologic diseases are related either to direct CNS invasion by the human immunodeficiency virus or by opportunistic pathogens. Despite the increasing availability of HAART, opportunistic infections continue to afflict patients in the Indian population. Classic CNS infections in the setting of AIDS include CNS TB, PML, HIV encephalitis, toxoplasmosis, Cryptococcus infections and PCNSL. MRI proved to be the preferred imaging modality in confirming the diagnosis due to its multi-planar capability and excellent soft tissue resolution. The imaging findings overlapped with one another but certain characteristic pattern was helpful in diagnosing a particular disease. This along with other advanced imaging technique and laboratory tests were vital to the neurology team which helped us in decision making related to a diagnostic

conclusion, treatment and further workup. We conclude with a statement that findings of TB, PML, HIV encephalopathy and Toxoplasma were the most common on evaluating HIV patients with CNS symptoms.

### ABBREVIATIONS:

TB Tuberculosis  
PML Progressive multi-focal leukoencephalopathy  
PCNSL Primary Central Nervous system Lymphoma  
HIVE HIV encephalopathy  
MRS Magnetic resonance spectroscopy  
Cho Choline  
NAA N-acetyl aspartate  
HAART Highly active anti-retroviral therapy

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