ORIGINAL RESEARCH PAPER

Radiodiagnosis

SPECTRUM OF MAGNETIC RESONANCE IMAGING IN EVALUATION OF CENTRAL NERVOUS SYSTEM LESIONS IN HUMAN IMMUNODEFICIENCY VIRUS INFECTED PATIENTS

KEY WORDS: HIV, Opportunistic Infections, MRI, DWI.

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ABSTRACT

The present study was undertaken to determine the role of MRI and Diffusion weighted imaging along with contrast and MRS in the identification and characterization of CNS lesions in HIV positive patients. The purpose of study was to characterize and differentiate various CNS lesions on MRI in HIV positive patients. The study group comprised of 62 patients with neurological involvement due to HIV or associated opportunistic infections and other HIV associated pathologies. In our study 69.4% cases of opportunistic infections, 11.29% cases of neoplastic and 19.35% cases of lesions due to HIV and immune system per se were found. Tuberculosis was the most common opportunistic infection 46.8% diagnosed by MRI, followed by toxoplasma 8.1%. It is recommended that in all HIV positive patients MRI should be combined with DWI, contrast and MRS which plays a crucial role in the diagnostic evaluation of patients suffering from CNS manifestations of HIV infection.

INTRODUCTION

HIV infection is characterized by a state of profound immunodeficiency resulting primarily from a progressive quantitative and qualitative deficiency of helper CD4 T cells. Thus leading to severe opportunistic infections and unusual malignancies affecting all major organ systems. These infections and malignancies are the main cause of morbidity and mortality in HIV positive patients.

About 36.7 million people worldwide are suffering from HIV infection and associated complications[1]. An estimated 2.08 million people in India are suffering from HIV infection with maximum prevalence in adults aged 15-49 years[2].

HIV can affect all organ systems including the central nervous system (CNS). It can cross the intact blood-brain barrier[3]. The spectrum of illnesses that occur depend on the CD4 T cell count with the more severe and life threatening complications of HIV infection occurring in patients with CD4 T cell counts <200 cells/μL. Among the more frequent opportunistic diseases that involve the CNS are toxoplasmosis, mycobacterial infections, cryptococcosis, progressive multifocal leukoencephalopathy (PML) and primary CNS lymphoma (PCNSL). Overall, secondary diseases of the CNS occur in approximately one-third of patients with AIDS[4].

Clinical findings are non-specific, and are often not helpful in distinguishing between the vast arrays of neurological disease processes in AIDS. Therefore imaging plays a crucial role in the diagnostic evaluation of patients suffering from HIV infection.

Magnetic Resonance Imaging (MRI) is the modality of choice for evaluating anatomical and physiological alterations in brain tissue. MRI is sensitive at detecting small lesions, white matter changes, altered white matter tracts, chemical shift and leptomeningeal enhancement. Since MRI is the mainstay of investigation of the CNS in AIDS, our study concentrates on the MRI appearances of various CNS infections in HIV positive patients.

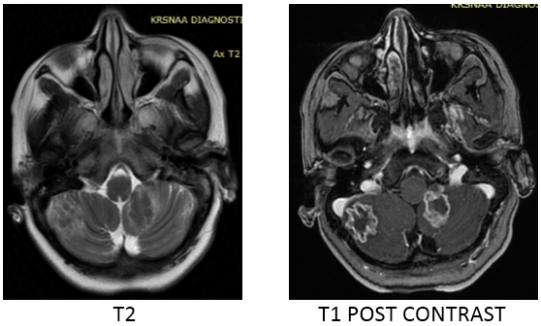
The purpose of the study was to characterise and differentiate the spectrum of CNS lesions in human immunodeficiency virus infected patients on magnetic resonance imaging.

MATERIALS AND METHODS

This prospective study was done in the Department of Radio-diagnosis of M.G.M. Medical College, Indore, Madhya Pradesh. The study group comprised of 62 patients with neurological involvement due to HIV or associated opportunistic infections and other HIV associated pathologies.

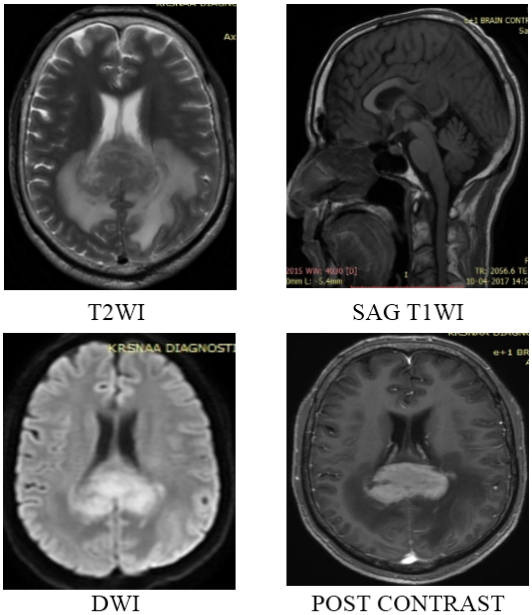
MRI Equipment:

MRI examination was performed on GE Signa 3 TESLA, 97 CHANNEL MAGNETIC RESONANCE IMAGING equipment using a dedicated head coil for imaging the brain. The sequences used were Axial T1W, Axial T1W fat sat, Sagittal T1W, Axial T2 W, Coronal T2W, FLAIR, SWI, DWI and Axial T1W Post Contrast.



T2 T1 POST CONTRAST

Figure 1: Solid Caseating Tubercular Granuloma



T2WI SAG T1WI

DWI POST CONTRAST

Figure 2: Lymphoma

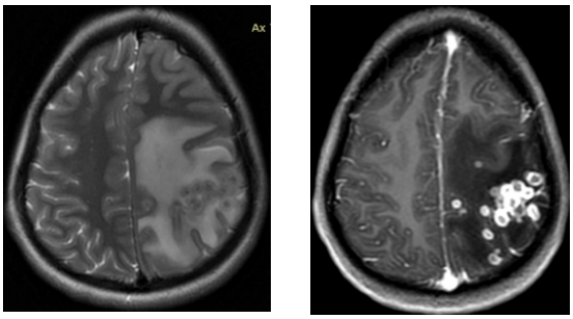


Figure 3: IRIS

RESULT

Patients of all ages were included in the study. The most common age group of patients was 15-45 years 66.1%. Majority of patients were male 71% and only 29% patients were females with a Male: Female ratio of 2.5:1.

Table 1: Distribution of cases on MRI and Follow Up

	Diagnosis	MRI (%)	Follow up (%)
Opportunistic Infections	Tuberculosis	46.8	45.1
	Toxoplasmosis	7.1	8.4
	Cryptococcosis	3.2	3.2
	Invasive Fungal Sinusitis	5.4	5.4
	PML	3.7	2.4
	CMV	3.2	3.2
	Total	69.4	67.7
Lesions Due to HIV and Immune System per se	HIV Encephalitis	11.29	9.63
	HIV Associated Vasculopathy	4.84	4.84
	IRIS	3.23	3.23
	Total	19.36	17.74
Neoplastic Lesions	Lymphoma	11.3	14.52
	Total	11.3	14.52

Tuberculosis was the most common opportunistic infection 46.8% diagnosed by MRI, followed by toxoplasma 7.1%. HIV Encephalitis was the most common lesion 11.29% due to HIV and only 3.23% cases of IRIS were found. Lymphoma 11.3% was the most common neoplastic lesion associated with HIV.

Table 2: Accuracy of MRI, DWI, Contrast and MRS In predicting Opportunistic Infections.

STATISTICS	MRI	DWI	CONTRAST	MRS	MRI+DWI +CONTRAST+MRS
SENSITIVITY	88.1%	90.5%	90.5%	90.5%	95.2%
SPECIFICITY	55.0%	65 %	60.0%	60.0%	80.0%
PPV	80.4%	84.4%	82.6%	82.6%	90.9%
NPV	68.7%	76.5%	75%	75%	88.9%

Morphological characters of the lesions combined with DWI, contrast and MRS have very high sensitivity specificity and overall accuracy in the identification and characterization of CNS lesions in HIV positive patients.

DISCUSSION

Tubercular granulomas were classified as non-caseating, solid caseating, liquid caseating, tubercular abscess and meningitis. A total of 46.8% patients in our study were diagnosed to be suffering from CNS Tuberculosis. Out of which, 11.1% patients had intracranial tuberculomas with associated meningeal involvement, 14.8% patients had only meningeal involvement without any parenchymal lesions, 55.6% patients had intracranial tuberculomas and 29.6% patients had intracranial tubercular abscess. The solid caseating granulomas were 22.5% and appeared hypointense on T2WI, iso– hypointense on T1W and FLAIR images with rim enhancement noted on post contrast images. The liquid caseating granulomas were 29.6% and appeared hypointense on T1WI and hyperintense on T2W/FLAIR images with a hypointense rim and showed ring enhancement on post contrast images. The non-caseating granulomas were 14.8% and appeared hypointense on T1WI and were seen as a focal hyperintensity on T2W and FLAIR images with nodular contrast enhancement. There were 29.6% cases of tubercular abscesses, which were large lesions (>3cm), appearing hypointense on T1WI, hyperintense on T2W and FLAIR images with a thick hypointense wall, showing peripheral rim enhancement on post contrast images. There was associated perilesional edema and mass effect with restricted diffusion on DWI and lipid/lactate peak on MRS.

3.7 % patients were diagnosed to be suffering from PML. There was patchy, asymmetric involvement of bilateral subcortical and periventricular white matter. Posterior fossa was involved in all the cases. The lesions appeared hypointense on T1WI and hyperintense on T2W and FLAIR images. There was no restricted diffusion on DWI, blooming on GRE, no associated edema, mass effect or contrast enhancement was noted.

3.2% patients were diagnosed as cryptococcal infection. In Cryptococcomas, multiple punctate as well as confluent T2/FLAIR hyperintensities involving bilateral basal ganglia, periventricular and subcortical white matter with subtle post contrast enhancement was seen.

7.1% cases were diagnosed with toxoplasmosis, there were multiple ring and nodular enhancing lesions noted in bilateral cerebral hemispheres involving the corticomedullary junction, bilateral basal ganglia, thalami and cerebellum.

There were 3.2% cases of Cytomegalovirus encephalitis characterized by patchy or confluent areas of high signal intensity in the periventricular white matter, which was better depicted on T2-weighted FLAIR images.

In our study 5.4% cases of Invasive fungal sinusitis were seen. On MRI, a T2 hyper-intense mass with bony wall destruction extending into the adjacent structures like orbits, maxillary floor, and hard palate and cranium with leptomeningeal enhancement was seen.

In HIV encephalitis, bilateral, symmetric and diffuse periventricular white matter hyper intensities were seen. A total of 11.29% patients in our study were diagnosed to be suffering from HIV Encephalitis.

4.84% cases were identified as HIV Associated vasculopathy with aneurysm formation and small vessel disease changes. Symmetrical and patchy multiple T2 and FLAIR hyperintensities seen in bilateral frontal and parietal lobes. 3.23% cases of tuberculoma of brain developed increasing parenchymal signal abnormalities with contrast enhancement of the parenchymal lesions and leptomeninges with increasing mass effect and restricted diffusion after receiving 6 weeks of HAART treatment. These cases were due to reactivation of immune system and were characterized under IRIS.

11.3% patients of our study were diagnosed with CNS Lymphoma which were T2 hypointense with central necrosis and haemorrhage with intense contrast enhancement and diffusion restriction. They were seen to be located mainly in midline few are extending to the corpus callosum.

On follow up with clinical and laboratorial profile opportunistic infection were 67.7% neoplastic were 14.52% and lesions due to HIV and immune system per se were 17.74%.

When the morphological characteristics of T1W and T2W images were considered alone, the sensitivity and NPV of the MRI morphology in predicting opportunistic infections turned out to be 88.1% and 68.7% respectively. The specificity and PPV were 55% and 80.4% respectively. The sensitivity and NPV of the DWI alone

in predicting opportunistic infections turned out to be 90.5% and 76.5% respectively. The specificity and PPV were 65% and 84.4% respectively. Slight increase in sensitivity and specificity was seen with DWI because one case of lymphoma was misdiagnosed as toxoplasmosis in conventional MRI because it showed diffusion restriction in DWI. The sensitivity and NPV of the contrast enhanced MRI alone in predicting opportunistic infections turned out to be 90.5% and 75% respectively. The specificity and PPV were 60% and 82.6% respectively. There is slight decrease in specificity and NPV with contrast because one case of high grade glioma was turned out to be tuberculoma. The sensitivity and NPV of the MRS alone in predicting opportunistic infections turned out to be 90.5% and 75% respectively. The specificity and PPV were 60% and 82.6% respectively. MRS also showed slight decrease in specificity as compared to DWI because one case of lymphoma was misdiagnosed as toxoplasmosis in our study.

When the morphological characteristics of T1W and T2W images were also added to the DWI, contrast enhanced MRI and MRS there is marked improvement in the sensitivity specificity, PPV and NPV which turned out to be 95.2%, 80.0%, 90.9% and 88.9% respectively.

When all the morphological characters of the lesions are combined with DWI, contrast and MRS there is a significant increase in sensitivity specificity and overall accuracy in the identification and characterization of CNS lesions in HIV positive patients.

CONCLUSION

It is recommended that in all HIV positive patients MRI should be combined with DWI, contrast and MRS which plays a crucial role in the diagnostic evaluation of patients suffering from CNS manifestations of HIV infection. It can categorize the various patterns of disease and highlight the main differential diagnoses for each pattern thus helping in early diagnosis and management and reducing the morbidity and mortality.

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