



Role of Imaging in the Management of Intracranial Lesions in Hiv Seropositive Patients

KEYWORDS

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INTRODUCTION :

Human immunodeficiency virus (HIV) is neurotropic¹ and crosses the blood– brain barrier at an early stage in the disease². Neurological disorders³ cause considerable morbidity and mortality in patients with AIDS with approximately 2/3rd of patients developing CNS involvement during the course of the disease. The spectrum⁷ of CNS disease in acquired immune deficiency syndrome (AIDS) is wide and can be broadly categorized into 1) Primary effects of HIV 2) Opportunistic infections 3) Neoplasms and 4) Vascular disease. Clinical findings are non-specific⁷, and are often unhelpful in distinguishing between the vast array of neurological disease processes in AIDS. Although recent advances in polymerase chain reaction (PCR) CSF analysis have increased the ability to make a specific diagnosis, a large part of the diagnostic process still relies on radiological interpretation with cerebrospinal fluid analysis. MRI⁷ is the modality of choice owing to its higher sensitivity of lesion detection and superior contrast resolution compared with CT. Nevertheless, the ready availability of CT allows it to remain a first line investigation, typically in the form of a screening tool prior to lumbar puncture.

AIMS & OBJECTIVES : The main aim of the study is 1) to describe the clinical and imaging features of CNS lesions in patients with HIV infection 2) To simplify the process of radiological analysis by categorizing the various patterns of disease & highlighting the main differentiating features for each pattern 3) To determine a practical approach for the management of HIV associated brain lesions

Potential HIV-specific mechanisms of central nervous system (CNS) injury⁹ HIV virus infects circulating monocytes, some of which may cross the blood brain barrier in an activated state. Immune activation may result from intra and extra CNS sources, including other peripheral reservoirs harbouring HIV. These mechanisms result in residual infection and inflammation, leading to astrocyte, macrophage, and microglial activation, neuronal dysfunction, and cognitive impairment. A decrease in the CD4 receptor–positive T lymphocytes is the best predictor of the potential development of opportunistic infections. The patient is most vulnerable when the CD4 count falls below 200 cells/ μ L¹⁰.

CD4 COUNT	PATHOLOGY*
600-800	Asymptomatic

400-600	Tuberculosis
<400	Cryptosporidiosis, Lymphoma
<200	Kaposi's sarcoma, HSV MAC Toxoplasma, PML, HIV – Encephalopathy, Cryptococcal meningitis

MATERIALS AND METHODS

This is a prospective study over 97 HIV seropositive adult patients with neurologic manifestations who were referred from departments of General Medicine, Neurology & Neurosurgery of Gandhi hospital for CT & MRI evaluation. The study extended for a period of 18 months from June 2014 to December 2015. CT was performed on EMO-TION 16 SLICE (SIEMENS Ltd) & MRI was performed on AVANTO 18 CHANNEL 1.5 T MRI (SIEMENS Ltd). Diagnosis drawn based on CT & MR findings is correlated with clinical responsiveness to treatment & CSF analysis except Progressive multifocal leukoencephalopathy.

PATIENT SELECTION:

94 HIV seropositive patients were included in our study aged between 15-75 yrs who presented with neurological deficits. To determine the seropositivity ELISA was done and for a few patients the seropositivity was later confirmed by western blot. All the patients underwent CD4+ counts; patients with a clinical diagnosis of meningitis were subjected to CSF analysis. The patients were then referred for radiological diagnosis.

EXCLUSION CRITERIA :

One patient was excluded since he was seronegative on western blot. Exclusion of thirty based on exclusion criteria either before or after performing CT& MRI. For two patients, contrast enhanced CT & MRI was not done due to deranged renal function. For twenty eight patients, MRI was not performed because the patient died twenty or was uncooperative eight.

TECHNIQUE :

CT was performed for 63 patients using JHU protocol with KV/ mAs/ Rotation time(sec)120/400/1.0 with collimation of 0.75 mm, slice thickness 4.5 mm for plain scan. In selected patients, 30 cc of iopamidol 370 was injected intravenously over a period of 4-5 sec after which the scan was repeated with the same protocols. MRI was performed using 4 channel HEAD COIL. A single-slice, three-axis localizer

scan was done followed by Axial T1 (TR 468, TE 11), Axial T2 (TR 4500, TE 111), sagittal T2 (TR 4000 TE 110), Coronal T2 (TR 4500, TE 124), Axial FLAIR (TR 9500 TE 102), Axial DWI (TR 3500, TE117). Axial GRE (TR 779, TE25) was done for selected patients with hemorrhages & toxoplasmosis. 10 cc of Gadoversetamide (Multihance) was injected intravenously over a period of 2 sec and FAT SAT Coronal T1 (TR 300, TE 70), FAT SAT Sag T1 (TR 500, TE 15) and FAT SAT axial T1 (TR 755, TE 111). MR spectroscopy (TE 135 msec or 30 msec) was performed for 25 patients with focal lesions who were analysed for peaks like lipid, lactate, NAA, Creatinine, choline. Single voxel, multivoxel spectroscopy was done with voxel placed at the maximum area of the lesion. Saturation bands were applied outside the volume of interest to reduce spatial contamination. We have calculated sensitivity of CT/ MRI & specificity of CT/ MRI

CLASSIFICATION BASED ON IMAGING FINDINGS^{5,7}

I	DIFFUSE WHITE MATTER DISEASE
II	PATCHY WHITE MATTER DISEASE
III	FOCAL MASS WITH ENHANCEMENT
IV	FOCAL MASS WITHOUT ENHANCEMENT
V	FOCAL LESION WITH NO MASS WITH ENHANCEMENT
VI	FOCAL LESION : NO MASS WITHOUT ENHANCEMENT
VII	MENINGITIS/ MENINGEAL DISEASE
VIII	VENTRICULITIS
IX	CEREBROVASCULAR DISEASE

DISCUSSION

This is a prospective study over 63 HIV seropositive adult patients with neurologic manifestations who were referred from various clinical departments of Gandhi hospital for CT & MRI to identify and characterize brain lesions. Diagnosis drawn based on CT & MR findings is correlated with clinical responsiveness to treatment & CSF analysis except Progressive Multifocal leukoencephalopathy, the radiological diagnosis was based on classical imageological and spectral criteria of identification. In the present study, peak age group affected is between 35-44 yrs and males are predominantly affected (62%). Most of the patients presented with headache (36.27%) followed by seizures (25.19%). Lobar predilection is found to be involving parietal lobe (18%) followed by temporal lobe (16%). Infectious lesions constituted majority of the cases in our study.

MORPHOLOGY OF VARIOUS PATHOLOGIES:

TUBERCULOSIS: In the present study, 11 out of 25 (44%) cases presented as enhancing focal lesions, 14 out of 25 cases (56%) presented with meningeal/cisternal enhancement, 7 out of 25 (28%) presented with hydrocephalus, and 1 patient presented with infarct (4%).

TABLE. 1 MORPHOLOGY OF TUBERCULOMAS ON MRI

Morphology	T1WI	T2WI	FLAIR
Hypointense	6	4	4
Hyperintense	0	2	2

In the present study, 6 cases of tuberculomas were hypointense on T1 WI, 4 out of 6 cases were hypointense

on T2WI & FLAIR; 2 out of 6 cases were hyperintense on T2 WI, FLAIR.

TABLE 2. MORPHOLOGY OF TUBERCULOUS ABSCESS ON MRI

Morphology	T1WI	T2WI	FLAIR
Hypointense	5	2	2
Hyperintense	0	3	3

In the present study, 5 cases of tuberculous abscess were hypointense on T1WI, 3 out of 5 cases were hyperintense on T2WI & FLAIR; & 2 out of 5 cases were hypointense on T2WI & FLAIR.

TABLE.3 DWI & MRS IN TUBERCULOUS ABSCESS

Imaging sequence	Present	Absent
MRS showing Lipid choline +	3	2
DWI showing restriction	0	5

In the present study, 3 out of 5 tuberculous abscesses showed Lipid choline peak in MRS All 5 abscess showed no restriction on DWI.

CONTRAST ENHANCEMENT :

In the present study, out of 25 cases of tuberculosis, 4 out of 6 tuberculomas showed ring enhancement and 2 showed nodular enhancement. All 5 tuberculous abscesses showed ring enhancement. In 15 cases of meningitis, 9 cases showed meningeal enhancement on CT, 14 cases showed meningeal enhancement on MRI 5 of which showed no enhancement on CT & 1 case showed no enhancement.

TABLE.4 COMPARITIVE EVALUATION OF VARIOUS TUBERCULOUS LESIONS

Author	No. of Study Patients	Meningeal Disease	Hydrocephalus	In-farcts	Enhancing Parenchymal Lesions
Berenguer et al	26	23%	42%	27%	15%
Villoria et al	35	45%	51%	23%	37%
Whiteman et al	25	36%	32%	36%	44%
Present study	25	56%	28%	4%	44%

A study by villoria et al (1992)¹⁹, on 35 patients with tuberculosis showed 45% meningeal enhancement & 23 % infarcts. Present study was comparable to his study. In the same study¹⁹, meningeal enhancement was seen in 48% of the CT studies with intravenous contrast medium and in 3 cases studied with MRI and IV gadolinium DPTA, in 2 of which CT was negative. A study by whiteman et al (1995)¹⁸, on 25 patients with tuberculosis showed 32% hydrocephalus & 44% enhancing parenchymal lesions. Present study is comparable to his study.

BACTERIAL ABSCESS: In the present study, all the 8 ab-

scesses were hypodense on CT with variable degrees of edema

TABLE.5 MORPHOLOGY ON MR

No. of lesions	T1W	T2W	FLAIR
2	Hypointense Centre, Isolense Rim	HyperIntense Centre, Hypointense Rim	Hypointense Centre, Hypointense Rim
6	HyperIntense Centre, Isolntense Rim	HyperIntense Centre, Hypolntense Rim	HyperIntense Centre, Hypolntense Rim

In the present study, out of 8 cases, 2 showed the above features which are suggestive of late cerebritis stage; 6 cases had the above the features which are suggestive of early capsule stage.

TABLE.6 COMPARITIVE EVALUATION OF BACTERIAL & TUBERCULOUS ABCESS

	BACTERIAL AB-CESS	TUBERCULOUS ABCESS
No. of patients	8	5
Ring Enhancement	6	5
Irregular Enhancement	2	0
Restriction on DWI	8	0
Conclusive MRS findings*	5	3

* Conclusive MRS findings included amino acid peak in bacterial abscesses & Lipid lactate peak with absence of choline peak in tuberculou abscesses28.

TABLE 7. COMPARITIVE EVALUATION OF BACTERIAL V/S TUBERCULOUS ABCESS

Author	Total No. of Patients With Abcess		Restriction on DWI		Conclusive MRS findings*	
	Bacterial	TB	Bacte-rial	TB	Bacte-rial	TB
Hassan et al	16	4	16	0	15	3
Present Study	8	5	8	0	5	3

In a study by Hussain et al (2006)27 , out of 25 cases of abscesses, 16 were bacterial & 4 were tuberculou. Out of 16 bacterial abscess, 15 cases & out of 4 tuberculou abscesses, 3 showed conclusive MRS findings. 16 out of 16 bacterial abscesses & out of 4 tuberculou abscesses 0 showed restriction on DWI. Present study is comparable to his study.

HIVE

MORPHOLOGY ON CT :3 out of 5 patients showed evidence of hypodensities on CT.

TABLE 7. MORPHOLOGY ON MRI

No of patients	T1WI	T2WI	FLAIR
5	Hypointense	Hyperintense	Hyperintense

In our study, 3 out of 5 patients showed NAA & Choline & Myoinositol

TABLE 8. COMPARITIVE EVALUATION OF CT & MRI FINDINGS IN HIVE

Author	No of patients	CT Abnormal	MR Abnormal	Conclusive MRS
Judith et al	22	18	22	Not done
James et al	10	Not done	10	10
Present Study	5	3	5	3

In a Study by Judith et al, (1988)25 out of 22 patients, 18 patients showed lesions on CT & 22 patients showed lesions on MRI which is comparable to the present study In a study by James et al (2009)24 10 out of 10 patients showed conclusive MRS findings

CRYPTOCOCCAL MENINGITIS

TABLE 8. COMPARITIVE EVALUATION OF CT & MRI IN CRYPTOCOCCAL MENINGITIS

Author	No of patients	CT Abnormal	MR Abnormal	Meningeal Enhancement	Hydrocephalus
Charlier et al	62	33	57	57	20

Lu & Chen et al	15	NOT DONE	14	9	5
Our Study	3	2	3	3	1

In a study by Charlier et al (2008)23, out of 62 patients, 33 patients had abnormal CT,57 patients had abnormal MRI. Present study was comparable to this study.In a study by Lu & Chen et al (2011)21,out of 15 patients, 9 patients had meningeal enhancement & 5 had hydrocephalus. Present study was comparable to this study.

INFARCT :

In the present study, 3 patients presented with arterial infarcts & 3 patients presented with venous hemorrhagic infarcts

TABLE. 9 COMPARITIVE EVALUATION OF ARTERIAL INFARCTS

Author	No of patients	In-farcts	Multiplicity		Opportunistic Infections
			Single	Multi-ple	
Gilliams et al	71	13	2	6	5
Present study	63	3	1	1	1

In a study by Gilliams et al, (1997)22, 13 out of 71 patients had infarcts, out of which 2 were single, 6 were multiple & 5 were due to opportunistic infections. The lesions which were multiple were most probably due to vasculitis. Present study showed opportunistic infection related infarcts which was comparable to this study.In the present study,

3 patients presented with hemorrhagic venous infarcts with CSVT. All the 3 patients were detected as HIV seropositive denovo & were not on any medication. No studies are available for comparing the incidence of CSVT in HIV & non HIV seropositive patients. All the 3 patients in our study responded well to low molecular weight heparin.

TOXOPLASMOSIS

In the present study, 4 patients were diagnosed with intracranial toxoplasmosis.

MORPHOLOGY ON CT :

All patients showed hypodense lesions with perilesional edema with ring enhancement post contrast. 3 out of 4 lesions showed mass effect.

TABLE. 10 MORPHOLOGY ON MRI

T1	T2	FLAIR	GRE	Conclusive MRS
Hypointense (2) Heterogeneous(2)	Hyperintense (4)	Hyperintense (4)	Blooming (2)	Lipid Lactate ↑ Choline, NAA↓(2)

In a study, by SIBTAIN et al (2002)7, toxoplasmosis presented as multiple lesions with hemorrhages, extensive edema, greater mass effect, appearing hypodense on CT with thin ring like enhancement & with no meningeal/ependymal enhancement showing ↑Lipid lactate peak & ↓ Choline, NAA on MRS unlike Primary CNS Lymphoma which presents as a single lesion with less hemorrhage, edema & mass effect, appearing hyperdense on CT with irregular enhancement showing ↑Choline & ↓NAA on MRS. The present study was comparable to this study & hence a diagnosis of toxoplasmosis was made

TABLE 11. COMPARITIVE EVALUATION OF INCIDENCE OF HEMORRHAGES WITH TOXOPLASMOSIS

Author	No of patients	Hemorrhages
Bhagavati et al	11	7
Present study	4	2

In a study by Bhagavati et al (2009)20, 7 out of 11 patients had hemorrhages. Our study was comparable to this study.

CMV VENTRICULITIS

In the present study, 1 case of ventriculitis was diagnosed based on enhancement & Was correlated with CSF analysis & CD4 count.

TABLE. 12 COMPARITIVE EVALUATION OF CMV VENTRICULITIS

Author	No of Patients	CMV ventriculitis
Mujtaba et al	12	3
Our study	63	1

In a study by Mujtaba et al (2003)16, ventriculitis suggested by subependymal enhancement & restriction on DWI images was correlated with CSF PCR for CMV antigen and found out the association to be significant. In the present study, such type of pattern was found in 1 case which was labelled as CMV ventriculitis.

GLIOMA & ASTROCYTOMA

In the present study, 2 cases of neuroglial tumors were

diagnosed, out of which 1 case was glioma & other was astrocytoma.

TABLE. 13 MORPHOLOGY ON CT

Tumour	Plain CT	Contrast CT	Edema	Mass effect
Glioma	Heterogeneous	Irregular	+	+
Astrocytoma	Heterogeneous	Irregular	-	+

TABLE. 14 MORPHOLOGY ON MRI

TUMOR	T1	T2	FLAIR	DWI	CON-TRAST	GRE	MRS
Glioma	Heterogeneous	Hyperintense	Hyperintense	Patchy	Irregular	Blooming	Choline lipid lactate +, NAA -
Astrocytoma	Hypointense	Hyperintense	Hyperintense	Peripheral	Irregular	Blooming	Choline +, NAA-

In a study by Gasnault et al (1988)15, who reported 2 cases of astrocytoma in 33 cases of HIV patients, he has described the association between HIV virus & malignant brain tumors by hypothesizing the suppression of immune system by HIV thereby resulting in the induction by oncovirus61 and activation of oncogenes14.

HEMORRHAGE DUE TO VASCULITIS

In the present study, 1 case of multifocal hemorrhages in sub cortical location has been reported. The patient was non alcoholic, normotensive with normal coagulation profile whose CSF analysis was inconclusive, was negative for syphilis and did not respond to 2 weeks of anti toxoplasmosis treatment. Martin et al (2005)29, reported a case of multifocal sub cortical hemorrhages in a young HIV seropositive patients with no opportunistic infections which implicated HIV induced amyloid deposition in vessels.

HERPES SIMPLEX ENCEPHALITIS

In the present study, 1 case of herpes encephalitis was reported. CT showed hypodensity in left temporal region MR showed T2 & FLAIR hyperintensity in left hippocampus & uncus with mild restriction on DWI. Chaiklang et al (2011)12, published a case study in which the initial CT was normal in a case of Herpes encephalitis but MRI after 1 week helped in the diagnosis. The MRI findings were comparable to our study.

TABLE. 15 COMPARITIVE EVALUATION OF HSV INFECTIONS

Author	No of opportunistic viral infections	Herpes simplex infection
Rajesh et al	10	1
Our study	2	1

Rajesh et al (2013)11, reported 10 cases of opportunistic viral encephalitis out of which 1 was Herpes encephalitis. However in the present study, only opportunistic viral infections were encountered due to the prevalence of bacterial infections. Sibtain et al (2002)7, Chaiklang et al (2011)12, reported the classical imaging findings in the di-

agnosis of Herpes encephalitis which was correlated with CSF PCR for HSV. Present study is comparable to their study.

PROGRESSIVE MULTIFOCAL LEUKOENCEPHALOPATHY

In our study, 1 case of PML was reported based on classical MR findings

TABLE. 16 MORPHOLOGY ON CT & MRI

CT	T1	T2	FLAIR	DWI	GRE
Hypodense	Hypol	Hyperl	Hyperl	Restrict-ed	-

White man et al (1999)²⁶, examined 47 HIV + patients with PML & described the imaging findings. David Simpson et al (2011)⁸, examined 65 HIV + patients with PML & described the imaging findings. Sibtan et al (2002)⁷, summarized differentiation criteria between PML & HIVE.

TABLE. 17 DIFFERENTIATION CRITERIA OF PML FROM HIVE

	PML	HIVE
CT	Hypodense	Isodense
T1w	Hypointense	Isointense
Contrast	Rarely	None
Distribution	Unilateral, asym-metrical, sub cortical	Bilateral symmetri-cal periventricular

Present study was comparable to these studies in terms of radiological features and hence a diagnosis of PML was made.

VIRAL ENCEPHALITIS

In the present study, 1 case of viral encephalitis was reported. The patient had 7059 levels of HIV copies in CSF/ mL.

MORPHOLOGY ON CT showed evidence of hypodensity in left Capsulo ganglionic region MORPHOLOGY ON MRI

T1	T2	FLAIR	DWI	GRE
Hypoin-tense	HyperIn-tense	HyperIn-tense	Restriction	-

Karen et al, (2003)⁶, reported acute encephalitis in 3 patients with chronic HIV infection secondary to increased CSF viral loads & T2 abnormalities; and described the imaging findings. Present study is comparable to this study in clinical, laboratory& imaging findings

SUMMARY

1. During the period of 18 months of the study, 63 cases were evaluated with CT& MRI.2) Maximum incidence of lesions was seen in the age group of 35-44 years with a male predominance.3)Majority of the patients presented with headache (36.27%) followed by seizures (25.19%).4) CD4+ counts along with CSF analysis for metabolites and antigen titres help in narrowing the differential diagnosis and are of utmost importance before referring the patient for an imaging investigation 5)Parietal lobe was most frequently involved region in our study.6)Tuberculosis(39.68%) constituted majority of the cases in our study.7)Out of twenty five tuberculosis, 56% of the patients had menin-

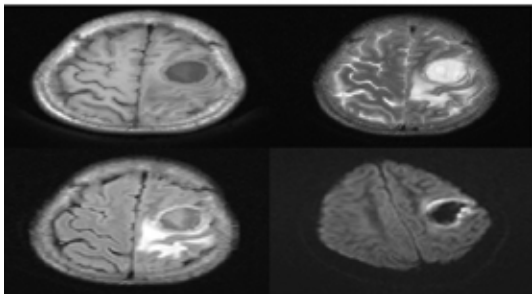
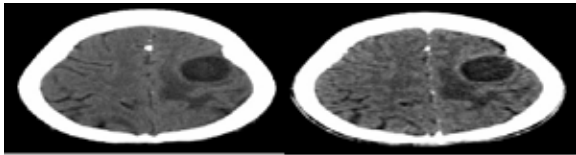
geal disease,44% had enhancing parenchymal lesions, 28% had hydrocephalus and 4% had infarcts.8)Tuberculous abscesses showed no restriction on DWI and Lipid lactate peak with absence of choline peak 9)Bacterial abscesses showed restriction on Diffusion Weighted Imaging and Amino acid peak on Magnetic Resonance Spectroscopy10) HIV Encephalopathy shows bilateral symmetrical T2 hyperintensities which show↓NAA & ↑Choline & Myoinositol on Magnetic Resonance Spectroscopy 11) Cryptococcal meningitis shows meningeal enhancement with hydrocephalus 12) Arterial infarcts can be due to HIV associated vasculitis due to tuberculosis or opportunistic infections 13) Venous hemorrhagic infarcts in vivo detected HIV seropositive patients are comparable to non HIV patients. However, further studies are required in ruling out Anti retroviral therapy related Cerebral venous sinus thrombosis 14) Toxoplasmosis shows hyperdense to hypodense lesions with edema on CT which are hyperintense on T2W, FLAIR-images, the morphology on T1W however complicated by hemorrhage & shows ring enhancement on contrast; >60% lesions show hemorrhages.15) CMVventriculoen-cephalitis rarely reveals imaging abnormality or may show sub ependymal enhancement which has to be correlated with Cerebro spinal fluid analysis for CMV antigen16) Gliomas in HIV patients are now in decline since the advent of Anti retroviral therapy. Some authors have correlated Simian virus 40 in the pathogenesis of Progressive multifocal leukoencephalopathy. However, the pathogenesis of HIV related glial tumors is beyond the scope of this study 17) Only one case has been reported in literature about Hemorrhages due to vasculitis and was related to HIV related amyloid deposition. However, autopsy was not done in that study or ours. Further studies are required in this aspect 18) Herpes encephalitis is diagnosed most specifically on MR with DWI imaging helping in localizing the pathology.19) Progressive multifocal leukoencephalopa-thy is mostly unilateral and asymmetric and is hypodense/intense on CT/MR images respective-ly. Classical imaging findings help diagnosing it & biopsy is rarely required.20) HIV Viral encephalitis is due to high plasma or CSF HIV viremia and is earliest detected by MRI 21) There is a overlap between imaging findings between diseases and careful analysis on MRI is required 22) In fifteen cases, the imaging findings were non specific and final diagnosis was achieved when correlated with clinical, laboratory (CD4+, CSF analysis for metabolites & antigen titres) 23)CT picked up abnormalities in fifty one out of fifty eight cases with a pathology. However, the specific etiology could be attributed singularly in twenty one cases. MRI picked up abnormalities in fifty eight patients but could attribute the etiology singularly in only forty three patients.24)MRI, especially T2W, FLAIR & Diffusion weighted imaging sequences are more sensitive than CT and Magnetic resonance spectroscopy helps in diagnosing few clinical conditions earlier.

CONCLUSION

HIV has varied clinical presentation with a considerable overlap. Of utmost importance, are the CD4 count & CSF analysis. Along with them, the imaging findings help in narrowing down the differential diagnosis. CT is the initial screening investigation to look for a focal or diffuse pathology. It helps in localizing the lesion and helps in deciding the further line of management.MRI provides highly detailed anatomic information and has become a main stay in the diagnosis of HIV associated brain pathologies in view of its excellent specificity. Contrast enhanced CT & MRI provided invaluable clues in diagnosing focal lesions and picking up the patterns of me-

ningeal &ependymal enhancement. DWI & MRS provide additional information regarding the nature of lesion and increase diagnostic accuracy. We conclude that CT is the screening modality of choice and MRI along with DWI & MRS in selected cases proved to be specific investigation of choice when correlated with CSF analysis, CD4+ count and response to treatment.

Pictures



TUBERCULOUS ABSCESS

MRI (P)- Lesion shows

T1W- hypointense centre & isointense rim,

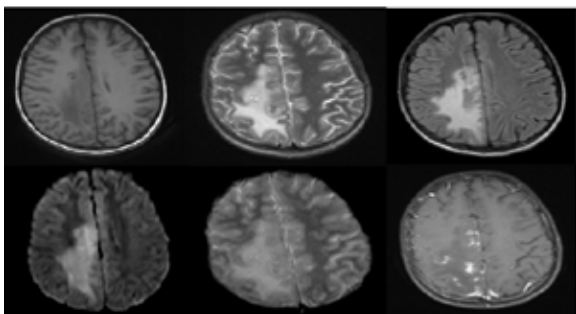
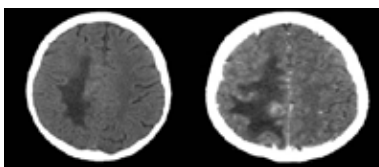
T2W- hyperintense on shows hypointense centre

FLAIR- hyperintense rim

no restriction on DWI and no blooming on GRE

MRS- Lipid Lactate +

MULTIPLE TUBERCULOMAS



CT (P+C) - Hypodense lesion with edema noted in right high parietal region with ring enhancement

MRI (P+ C)- lesion is

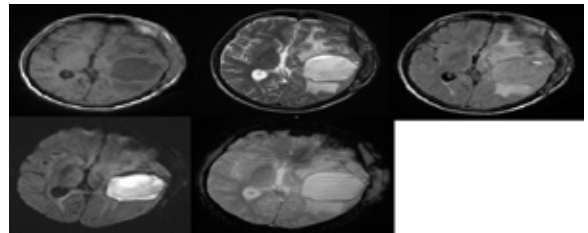
T1W- hypointense

T2 & FLAIR is hyperintense

no restriction on DWI , no blooming on GRE.

Post contrast, multiple ring enhancing lesions are seen

BACTERIAL ABSCESS



MRI (P)- Lesion shows

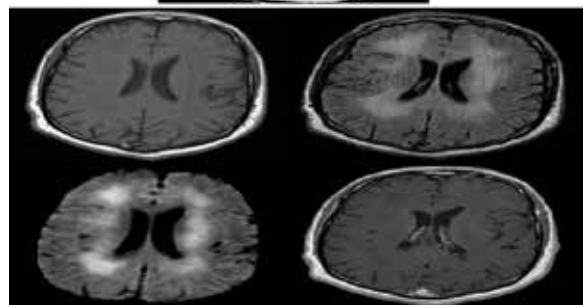
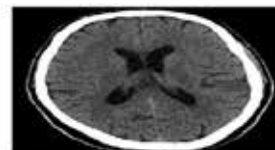
T1W- hypointense centre & isointense rim,

T2W - hyperintense centre & hypointense rim,

FLAIR- hypointense rim & centre

showing central restriction on DWI and no blooming on GRE,

**MR SPECTROSCOPY- Amino acid+ Lipid Lactate
HIV ENCEPHALOPATHY**



CT (P)- Normal Study.

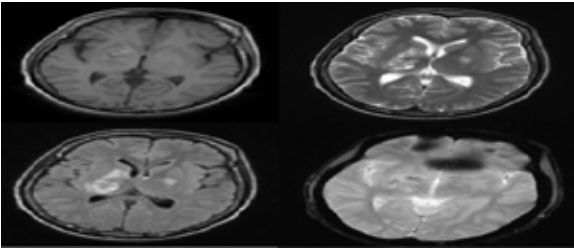
MRI (P)- Bilateral periventricular white matter

T1 hypointensity

T2 & FLAIR hyperintense

Restriction on DWI

TOXOPLASMOSIS



MRI (P+ C)- Lesion is

T1W- hypointense

T2 & FLAIR - hyperintense,

showing blooming on GRE.

Post contrast, ring enhancement was seen

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