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# MR Imaging In Meningoencephalitis With Its Clinical And CSF Correlation

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## ABSTRACT

Background: Encephalitis is a fatal disease syndrome where patients usually present with pyrexia and neurological derangement, which requires prompt investigations and urgent vigorous management to prevent irreversible neurological damage. Objective: Our aim was to study the spectrum of MRI findings in cases of meningo-encephalitis and its correlation with CSF findings and clinical background. Methodology: Using a standard data collection method from 50 patients undergoing MR examination and findings suggestive of meningo-encephalitis were evaluated retrospectively. CSF findings and clinical history were recorded and correlation of CSF and clinical history with MR findings was established in MR diagnosed meningo-encephalitis cases. Results: Out of the 50 patients, 29 were females and 21 were males and the mean age was 37.02 +/-15.25SD. Seasonal variations were noted with most patients being found in post rainy season. Abnormal CSF findings were seen in 74% patients with diffuse bilateral cerebral hemispheric involvement as the most common presentation (38%) and most common chief complaint encountered was pyrexia with altered sensorium (36%). Conclusion: Neuroimaging technique, particularly MRI is useful parameters in the early diagnosis of meningo-encephalitis. A conventional CSF study has asignificant positive correlation in the diagnosis of meningo-encephalitis along with relevant clinical history.

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## INTRODUCTION

Encephalitis is a fatal disease syndrome where patient usually present with pyrexia and neurological derangement.[1] This is acute emergency which requires prompt investigations and urgent vigorous management to prevent irreversible neurological damage, particularly when there is rapid deterioration. Apart from routine tests, brain imaging and CSF evaluation are the most relevant and mandatory tests to diagnose encephalitis. Acute Encephalitis Syndrome (AES) is a growing problem in India, the incidence being 0.42/ Lac population/year.[2,3] In the USA it has been estimated that herpes simplex encephalitis (HSE), the most important treatable viral encephalitis, has an incidence of about one case per million per year.[4]

***Imaging of specific disorders***

**Herpes simplex encephalitis:** Typical MR imaging shows progressively more widespread abnormalities with the involvement of the temporal lobe, insula and cingulate gyri, haemorrhage and enhancement are being late features.[5] **HIV-1:** MRI usually shows atrophy and non-specific white matter changes. Neuroimaging is an important diagnostic tool for opportunistic infections.

**Miscellaneous viral infections:** In polio and coxsackie virus infections, T2-weighted MRI may show hyperintensities in the midbrain and anterior horn of spinal cord.[6] In EBV infection hyper intensities in the basal ganglia and thalami may be observed on T2-weighted MRI.[7] West Nile virus (WNV) can be associated with enhancement of leptomeninges, the periventricular areas, or both, on MRI.[8] T2-weighted MRI of Japanese encephalitis can show hyper intensities in bilateral thalami, brainstem and cerebellum. **ADEM:** T2WI and FLAIR scans present multifocal, usually bilateral, but asymmetric and large hyperintense lesions, involving peripheral white and grey matter.[9] **PML:** T2-weighted sequences initially show multiple, bilateral, non-enhancing, subcortical white matter hyperintensities in the parietooccipital area.[10] **Rasmussen's encephalitis:** MRI abnormalities include high signal on T2-weighted MR images in cortex and white matter, cortical atrophy that usually involves the fronto-insular region, with mild or severe enlargement of the lateral ventricle and moderate atrophy of the head of the caudate nucleus. In paraneoplastic limbic encephalitis MRI FLAIR and DWI depict bilateral involvement of the medial temporal lobes and multifocal involvement of the brain.[11]

**Significance of MR Imaging in Meningo-Encephalitis:** Magnetic resonance imaging (MRI) is more sensitive and specific than CT for the evaluation of viral encephalitis.[12] The advantages of MRI include the use of non-ionizing radiation, multiplanar imaging capability, improved contrast of soft tissue, and high anatomical resolution. It allows earlier detection and treatment of inflammatory processes. New MR technologies include procedures that can increase sensitivity to small, yet clinically relevant lesions. Diffusion-weighted MRI (DWI) enables the separation of cytotoxic from vasogenic oedema and distinguishes recent from old insult, which can often be difficult on routine T2 and FLAIR imaging.

**Significance of CSF Study:** The CSF is a convenient specimen and is recommended for neurological viral diagnosis in general.[13] In patients with viral encephalitis, CSF analysis typically reveals a mild mononuclear pleocytosis. CSF protein concentration is generally mildly or moderately elevated. A decreased CSF glucose concentration is unusual in viral encephalitis and suggests disease caused by bacteria. Although about 5% of patients with HSE have a normal CSF profile, the typical features of HSE are a lymphocyte cell

of 10–200/mm3 and an increased protein of 0.6–6 g/l.[14] The CSF findings in patients with ADEM are generally similar to those seen in patients with viral encephalitis-that is, lymphocytic pleocytosis, elevated protein concentration, and normal glucose concentration. Pleocytosis in ADEM tends to be less marked than in acute infectious encephalitis, and it may be absent; differentiating it from encephalitis.

**Differntial Diagnosis:** Imaging findings seen in meningo-encephalitis can mimic illneses like inflammatory disorders, various encephalopathies, ADEM and neoplastic lesions.[15] As treatment protocol varies with the pathologies mentioned above, clinical correlation and CSF evaluation will help in differentiating these disorders.

## METHODOLOGY:

The present study was conducted in the department of the Radiodiagnosis, RNT Medical College & MB Hospital, Udaipur, Rajasthan after taking permission from the institutional ethical committee. In this retrospective study, 50 patients undergoing MR examination, showing imaging findings suggestive of meningo-encephalitis were evaluated. Various MRI sequences like T1WI (T1 weighted imaging), T2WI (T2 weighted imaging), FLAIR (Fluid attenuated inversion recovery sequence), DWI (Diffusion weighted imaging), and Contrast study- AxT1, SagT1, CorT1 were studied. Meningo-encephalitis were typically identified as hyper intensities on T2 and FLAIR sequences, showing restriction on DWI, which may show contrast enhancement. The pattern of anatomical distribution was noted; as different viral infections have a typical anatomical location. CSF examination details were noted as CSF cytology (TLC, lymphocytes, neutrophils), CSF Sugar and protein. A presumptive diagnosis based on typical CSF findings was made. With regard to article on cerebrospinal fluid analysis by Seehusen,[16] we categorized CSF findings into normal, viral, tubercular and pyogenic meningo-encephalitis.**(Table-1)**

**Table 1. Types of Meningo-encephalitis**

| | CSF | | | | |
|---|---|---|---|---|---|
| | Sugar | Protein | TLC | Lymphocytes | Neutrophils |
| Normal | 40-75 | 15-45 | 0-5 | NIL | NIL |
| Viral | Normal | Raised or high normal | High | Predominant | - |
| Tubercular | Low (<50%) | Much raised | High | Predominant | - |
| Pyogenic | low (<50%) | Raised | Very high | - | Predominant |

Correlation of CSF and clinical history with MR findings was established in MR diagnosed meningoencephalitis cases.

## RESULT & DISCUSSION

In the present study, 50 patients were evaluated between 18-80 years of age, in which presumptive diagnosis of meningo-encephalitis were given on MR examination. In this study a spectrum of imaging in different MR sequences, chief presenting complaint with duration, date of MR imaging and CSF findings were recorded as described above. Out of 50 patients, 29 were females and 21 were males. The majority of the patients, i.e. 22 (44%) belonged to 30-50 age group and the mean age of the study population was 37.02 +/-15.25SD. Out of the 50, 28 patients

presented to the hospital during July to November period, which is a post rainy season. This suggests seasonal variation in occurrence of meningo-encephalitis. A similar study was done by Alireza Mosavi-Jarrahi on temporal analysis of the incidence of meningitis, where they found that seasonal variations in the occurrence of meningitis showed a higher risk in the spring season, with a rate ratio of 1.31 (95% CI, 1.20, 1.41), and in the fall, with a rate ratio of 1.16 (95% CI, 1.06, 1.27).[17]

In our study the most common chief complaint encountered was pyrexia with altered sensorium (36%), which shows significant high positive correlation with the diagnosis of AME (p <0.001) **(Table-2)**. Kennedy and Choudhuri, in their article on Herpes Simplex Encephalitis stated that the index of suspicion of HSE should always be high for a patient presenting with the typical features of encephalitis such as fever, headache, confusion, and clouding of consciousness.[18]

**Table 2. Differential chief complaints.**

| Chief complaint | Normal | Viral | Tubercular | Pyogenic |
|---|---|---|---|---|
| Pyrexia with Alt senso | 30.80% | 36.70% | 60.00% | 0.00% |
| Pyrexia with seizures | 15.40% | 16.70% | 0.00% | 0.00% |
| LOC | 15.40% | 13.30% | 20.00% | 0.00% |
| Fever with headache | 7.70% | 3.30% | 20.00% | 50.00% |
| Generalized weakness | 7.70% | 16.70% | 0.00% | 50.00% |
| Fever with chills | 23.10% | 0.00% | 0.00% | 0.00% |
| Others | 0.00% | 13.30% | 0.00% | 0.00% |

In our study, most of the patients 37 (74%) presented within 2 to 5 days of duration of illness which suggested the acute presentation of this disease. MR revealed diffuse bilateral cerebral hemispheric involvement as the most common presentation (38%), followed by temporal lobe (24%). **(Table 3)** T1 MR sequences showed isointense signals in (94%) cases, T2 and FLAIR sequences showed hyperintense signals in (82%) and (86%) respectively. DWI showed restriction in (50%) cases, out of which 28% were patchy restricted. Post contrast (gadolinium) T1 sequences showed no enhancement in (60%) cases. Edema was seen in (64%) cases. Hemorrhage was seen only in (10%) cases. Among all MR sequences; T2, FLAIR and DWI sequences were more sensitive and specific to diagnose AME. Kennedy and Choudhuri, in their article on Herpes Simplex Encephalitis suggested that the diagnosis of HSE is usually established from the combination of the clinical and investigative features. Magnetic resonance imaging (MRI) provides the most sensitive method of detecting early lesions and is the imaging of choice in HSE;[19] if MRI is available it should be the first diagnostic step after clinical assessment.

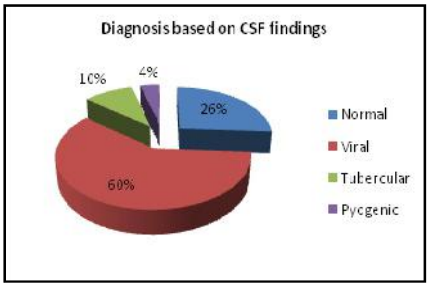
**Table 3. Differential MRI findings.**

| Anatomical location | Normal | Viral | Tubercular | Pyogenic |
|---|---|---|---|---|
| Diffuse bilateral | 23.10% | 36.70% | 60.00% | 100.00% |
| Temporal lobe | 15.40% | 30.00% | 20.00% | 0.00% |
| Frontal lobe | 7.70% | 6.70% | 20.00% | 0.00% |
| Basal ganglia and thalamus | 23.10% | 3.30% | 0.00% | 0.00% |
| Corpus callosum | 0.00% | 10.00% | 0.00% | 0.00% |
| Hippocampus | 23.10% | 6.70% | 0.00% | 0.00% |
| Others | 7.70% | 6.70% | 0.00% | 0.00% |

In this study, out of 50 patients, 37 (74%) showed abnormal CSF findings, which depict significant high positive correlation with the diagnosis of AME (p <0.001). CSF pleocytosis was present in (68%) and raised

CSF protein was demonstrated in 64 % patients, while low sugar was seen in 20% cases. On the basis of CSF findings 30 out of 50 patients were suggestive of viral meningo-encephalitis **(Diagram 1)** in which the most common clinical symptom was pyrexia with altered sensorium (36.7% patients). The most common site of involvement was diffuse bilateral cerebral hemisphere 36.7%, followed by temporal lobe 30%. Edema was present in 76.7% and haemorrhage was present in 10% cases. A similar study was done by Kennedy and Choudhuri,; in their article on Herpes Simplex Encephalitis suggested that Examination of the cerebrospinal fluid (CSF) is of considerable diagnostic value in HSE and should always be performed after computed tomography or MRI.[20]

Diagram1




## CONCLUSION

In patients presenting as pyrexia with neurological derangement MR imaging plays a pivotal role in the diagnosis of meningo-encephalitis. MRI has been shown to be highly sensitive and specific in identifying the underlying etiopathogenesis in meningo-encephalitis because of its high spatial resolution, excellent inherent soft tissue contrast, multipanar imaging capability with lack of ionizing radiation as an additional benefit. A conventional CSF study has a significant positive correlation in the diagnosis of meningo-encephalitis. Hence we conclude that MRI evaluation plays a significant role in the diagnosis of meningo-encephalitis along with CSF study and relevant clinical history.

**Conflict of Interest**: None declared.

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## CHARACTERISTIC IMAGING FEATURES IN MENINGO-ENCEPHALITIS

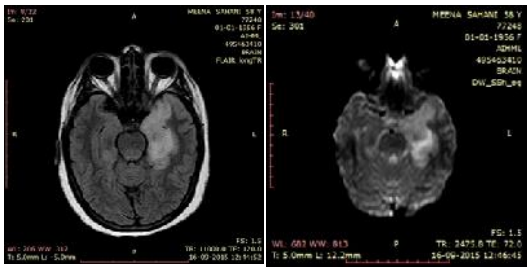

***Fig: Axial FLAIR and DWI images showing areas of hyperintense signals in median temporal lobe including hippocampus and parahippocampal gyrus.***

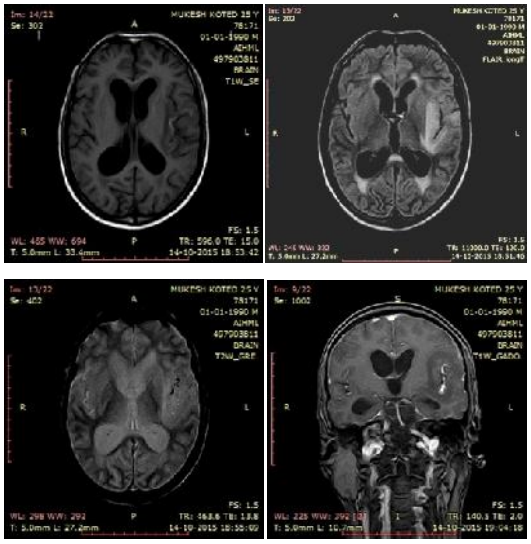

***Fig: Abnormal signals in left temporal lobe including insular cortex and external capsule, appearing isointense on T1. Faint hyperintenity on T1 and susceptibility on gradient sequence suggest haemorrhage. Post contrast coronal T1W image shows leptomeningeal enhancement.***