IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 1 Ser.16 (January. 2020), PP 37-46
www.iosrjournals.org

MRI Brain Evaluation in a Recent Outbreak of Japanese Encephalitis with Clinico-Radiological Correlation

Dr. Esther L. Pachuau[1], Dr.Ngaizavung Hauzel[2], Dr.Meenakumari Ayekpam[3] , Dr.S.Subashchandra Singh[4], Dr.S. Krishna Bharati[5], Dr.Amitabha Datta[6], Dr.Md Irshad[7], Dr.Sarvesh Ramanathan[8]

[1-2,5-8] Post Graduate(s),[3] Professor and HOD,[4] Professor, Department of Radiodiagnosis, Regional Institute of Medical Sciences(RIMS), Imphal, Manipur,India.
**Corresponding Author:Dr. Esther L.Pachuau*

Abstract:
Background: *Japanese Encephalitis is one of the most common causes of encephalitides in the world with an estimated yearly prevalence being 30-50,000 and mortality accounting to 10-15,000. Even in patients who recover there is a high prevalence of residual neurological deficit, hence early diagnosis and management play a crucial role in reducing the morbidity and mortality. MRI has a high sensitivity for picking up typical neuroparenchymal abnormalities and in cases where the diagnosis is a dilemma, it aids in confirming the disease thereby reducing the disease burden.*
Aim: *To evaluate the MRI findings in a recent outbreak of Japanese Encephalitis in Manipur, with clinico-radiological correlation.*
Methods: *Retrospective, cross-sectional, descriptive study was carried out at Regional Institute of Medical Sciences, Imphal, Manipur, India, on 26 lab proven JE IgM ELISA positive and equivocal patients, who presented during a recent outbreak of JE, in the months of July-September 2019, and who underwent an MRI of the brain.*
Results: *All patients were scanned during the acute and subacute phase of the disease, with male: female ratio being 12:14 (46.2%:53.8%) and age of the patients ranging from a minimum of 7 years to a maximum of 67 years, with a mean age of 28.1years, SD +/- 16.5. The commonest combination of presenting complaints was fever, headache and altered sensorium(38.5%). The distribution of MRI findings was predominantly in the thalamus(80.6%) and hippocampus(49.9%) followed by the substantia nigra including brainstem (34.5%), caudate nucleus (23%), cerebral cortex(22.9%), lentiform nucleus (15.3%)and splenium (3.8%). Among the patients with bilateral neuroparenchymal involvement, there was a predominance of asymmetric signal abnormality (63.5%) which is not a commonly described finding in Japanese Encephalitis in past literature. Unilateral findings were also present in some of the patients.*
Conclusion: *MRI brain, especially T2 FLAIR sequence is a sensitive tool to diagnose Japanese Encephalitis which picks up signal abnormality even by the fourth day of symptoms in our study. In the appropriate clinical setting, JE should be highly suspected even in cases showing atypical bilateral asymmetric involvement of the thalamus, basal ganglia, substantia nigra and hippocampus and also in cases that may have unilateral involvement. Hippocampal involvement is very common in JE and should not be mistaken for other causes like Herpes Simplex Encephalitis.*

Keyword: *Japanese Encephalitis, MRI, Asymmetric, Thalamus, Hippocampal, caudate nucleus, Splenium, cerebral cortex, JE ELISA IgM.*

Date of Submission: 13-01-2020 Date of Acceptance: 29-01-2020

I. Introduction

Japanese Encephalitis (JE) is still one of the most common human endemic encephalitides with significant disease burden and high prevalence in South East Asia including several states in North East India where there are recurrent outbreaks.[1,2] JE is caused by the Japanese Encephalitis Virus (JEV) which belongs to the genus Flavivirus of Flaviviridae family, the vector of the disease being Culex tritaeniorhynchus mosquito and the amplifying hosts being pigs and birds.[3] The neurotropic virus causes typical changes in MRI which help to differentiate it from other viral encephalitides, encephalopathy and acute disseminated encephalomyelitis.[4] The typical findings on MRI described are bilateral thalamic, substantia nigra, basal ganglia, brainstem, cerebellum, cerebral cortex, and white matter lesions.[5,6] The aim of this study is to evaluate the spectrum of MRI

findings during a recent JE outbreak in the post-monsoon season of July -September 2019 in the state of Manipur, India and correlate the clinical picture with severity and extent of findings in MRI.

II. Aim

To enumerate the MRI brain findings in lab-tested JE cases (positive and equivocal) in the endemic state of Manipur during a recent outbreak of JE with clinical correlation.

III. Methods

Patient selection:

This retrospective cross-sectional study was conducted in the Department of Radiodiagnosis, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur, India. All patients who underwent MRI of the brain for suspected or diagnosed Japanese Encephalitis or Acute encephalitis syndrome during the JE outbreak witnessed during the months of July-Sept 2019 were included in the study. The following inclusion/exclusion criteria were observed and data from the Department /Institution's archive was collected.

Inclusion Criteria:

- JE positive cases
- Probable JE cases
- All age groups
- Cases where MRI brain was performed

Exclusion Criteria:

- JE negative cases
- Acute encephalitis syndrome [AES] of other etiology, like herpes simplex virus encephalitis, dengue, malaria, bacterial and fungal meningitis were excluded from the study
- Incomplete study/ MRI not done

Sample size and sampling:

All cases suspected or diagnosed with JE for whom MRI brain was done during the period of July to September 2019 were included in the study.

Definitions of variables:

- **Acute encephalitis syndrome [AES]-**according to the manual for JE diagnosis from the World Health Organization (WHO), defined as patients with acute febrile illness and altered mental status or new-onset seizures[1]
- **Altered mental status-** comprising of confusion, altered behavior, disorientation, coma or inability to talk, or new-onset seizures
- **Focal neurological deficits** - acute paralysis, cranial nerve signs, brainstem signs, lateralizing signs or pyramidal or extrapyramidal signs
- **JE positive cases** – serum/CSF/Serum and CSF positive for JE IgM-capture ELISA is defined as OD value of sample tested exceeds OD of Negative control by a factor 5.0 (Sample OD>= Negative control OD x5.0)
- **JE equivocal cases** - serum/CSF/Serum and CSF equivocal/ weak positive for JE IgM-capture ELISA defined as OD value of sample tested exceeds OD of Negative control by a factor 3.0 (Sample OD> Negative control OD x 3.0), but is less than OD of Negative control by a factor 5.0(Sample OD<Negative Control OD x5.0)
- **Acute febrile seizures**- child aged 6months to 6 years, the only finding being fever and a single generalized tonic-clonic convulsion lasting for less than 15 minutes and who recovers consciousness within 60minutes of seizures
- **Children:** age under 12 years
- **Adult:** age above 12 years
- **Acute AEV**<7 days
- **Subacute AEV**>7-21days
- **Chronic AEV**>21days

Outcome variables:

- Enumeration of MRI findings in terms of area of involvement, the intensity of lesions, laterality, and symmetricity of findings when bilateral involvement was noted
- Correlation of MRI findings with clinical data

IV. Materials And Methods:

The study was carried out at the Regional Institute of Medical Sciences, Imphal, which is a tertiary level health institute in the JE endemic state of Manipur, situated in the North-Eastern region of India. The data for the study were collected for the months of July to September 2019, during the period of a recent outbreak of JE documented in the state.

Patients presenting with AES, inclusive of all ages and both genders fulfilling the inclusion criteria were included in the study. Features of meningism, extrapyramidal symptoms, and any other acute neurological deficit were also documented. Acute febrile seizure cases were excluded as a cause of new-onset of seizures

Laboratory tests were done using serum and/or CSF samples, which were tested using specific JE IgM antibody capture-enzyme-linked immunosorbent assay kits, ELISA kits obtained from Arbovirus Diagnostics, National Institute of Virology (NIV), Pune, India. Results of the tests were interpreted according to the instructions for cut-off in the kit formula and all negative cases were excluded from the study. The remaining patients were grouped into two groups;

i) Lab confirmed JE: Presence of IgM antibodies specific to JE virus in a single sample of cerebrospinal fluid (CSF) or serum, as detected by an IgM-capture ELISA specifically for JE virus; and

ii) Probable JE: equivocal or weak positive cases for IgM JE in either serum or CSF or both using the ELISA that occurs in close geographic and temporal relationship to a laboratory-confirmed case of JE, in the context of an outbreak.

Study Tools:

The study was done using a 1T scanner (Seimens MAGNETOM, Harmony Maestro Class, Germany) with the following protocols; T1-weighted (T1W) [repetition time(TR)/ echo time(TE)/excitation =500/50/3 ms], T2-weighted (T2W) [TR/TE/excitation=4000/80-90/1 ms] spin-echo (SE) sequence, T2 Fluid Attenuated Inversion Recovery (FLAIR) [TR/TE/excitation=9000/89-91/1ms], Diffusion Weighted Image (DWI) and Apparent Coefficient Diffusion(ADC). Gadolinium enhanced study was not performed.

MRI findings were classified according to the region of involvement in the brain viz. the thalamus, basal ganglia, brainstem, brainstem including substantia nigra, substantia nigra alone, hippocampus, cerebral cortex, cerebral white matter. Patients were further grouped as those having unilateral or bilateral abnormality and if bilateral, whether findings were symmetric or asymmetric in terms of signal intensity and area of involvement. Follow up MRI was done for patients whenever possible. The images were initially reviewed and interpreted by two independent readers and final interpretation was confirmed by senior radiologists with more than 10 years of experience who were blinded to the categorization of the patients.

All the patients' records viz. blood counts, hemogram, urinalysis, serum chemistry was recorded and CSF study whenever done was recorded for protein, sugar, cells, adenosine deaminase, culture for bacteria, smear for cryptococcus and IgM JE ELISA.

Statistical Analysis:

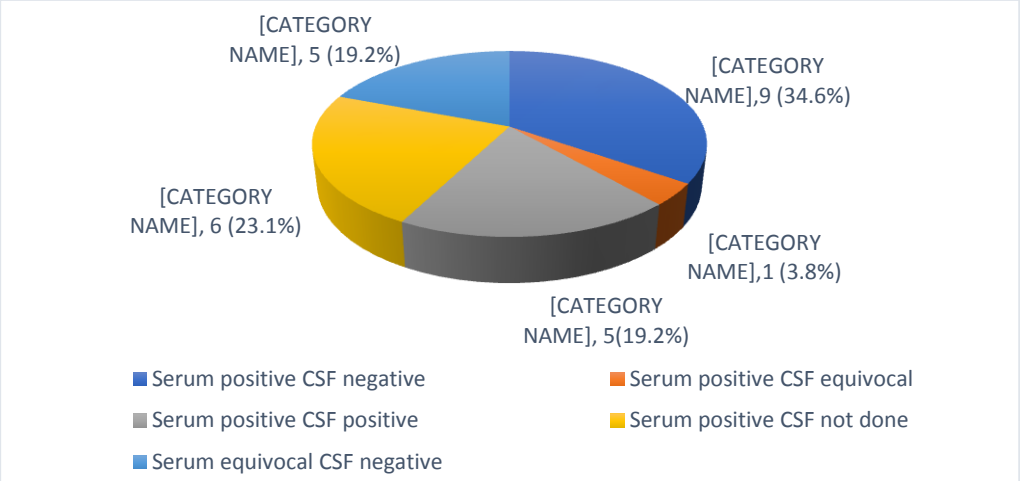
The results noted from our study were tabulated and expressed in the form of ratios, percentages, mean with standard deviation (SD).

V. Results:

Demography and clinical data:

Our study population consisted of 38 patients, out of whom 10 were JE negative and 2 were found to be CMV positive, and hence excluded from the study. There was a total of 26 patients who fulfilled the inclusion criteria for the study. The male to female ratio was 12:14 (46.2%:53.8%) and the age of the patients ranged from a minimum of 7 years to a maximum of 67 years, with a mean age of 28.1years, SD +/- 16.5. The total number of children was only 7(26.9%) as compared to the number of adults which was 19(73.1%). The distribution of cases according to the districts in Manipur showed that the majority of the cases 12 (46.2%) were from Thoubal District, which was in accordance with the pattern of increased incidence noted in the same district, during the time of the study. The total number of lab positive JE cases was 22(84.6%) as compared to probable JE cases (equivocal) which were 4(15.4%). The frequency and distribution of cases according to test positivity in either serum or CSF or both are given in Figure 1.

Fig 1: Distribution of JE IgM ELISA Positive and Equivocal cases.



The duration of illness prior to MRI study ranged from a minimum of 4 days to a maximum of 18days with a mean of 9.69days SD+/- 3.9, with no patients presenting in the chronic stage. The distribution of duration of illness in adults and children shows 12(46.2%) patients presenting in the acute phase of the disease and 14(53.8%) presenting in the subacute phase. Among the presenting combination of symptoms, fever with headache and altered sensorium was the most frequent and seen in 10(38.5%) patients, followed combination of symptoms of fever and headache 7(26.9%). Seizure was seen in two patients (7.7%) [1-14years,1-10years] while signs of meningism were present in two patients (7.7%) [1-16years,1-50years]. One child presented with features of third cranial nerve palsy (FND) (3.8%). Altered sensorium was present in 14patients (53.8%) [4-children, 10-adults]. 3 patients, all adults (11.5%) presented with associated renal function derangement. None of the patients had liver function derangement or other significant metabolic abnormality to cause signal abnormalities in MRI brain. One patient (3.4%) (adult) was found to be positive for IgM Dengue ELISA, however, his platelet count was normal and he came from the endemic district of Thoubal, with his MRI findings showing typical involvement of bilateral thalami, basal ganglia, cerebral cortices.

Radiological findings:

21 patients [adults-16, children-5] (80.3%) showed changes in the thalamus out of which 15 [adults-13, children-2] (71.4%) were bilateral and 6 [adults-3, children- 3] (28.57%) were unilateral. Involvement of the lentiform nucleus was seen in 4(15.3%) [adults 2, children 2] patients out of which 3 (75%) [adults-2, children-1] had bilateral involvement. The caudate head involvement was seen in 6 (23.1%) [adults- 4, children-2] of patients out of whom 5(83.3%) [adults-3, children-2] were bilateral. Cerebral cortical involvement was seen in 6 (23.1%) [adults-5, children-1] of the patients, out of whom 4 had unilateral (15.3%) and 2 had bilateral (7.6%) involvement. Hippocampal involvement was seen in 13(50%) [child-4, adult-9] of the patients out of whom 12(46.1%) were bilateral involvement [child-4, adult-8]. Substantia nigra involvement was seen in 9(34.5%) [adults-8, children-1] patients of whom 2(22.2%) [adult-2] had adjacent parts of brain stem involvement, and majority 8(88.8%) [adults 7(36.8%), child 1(14.3%)] showed bilateral involvement. One patient showed splenial involvement (3.8%) in form of T2 and T2 FLAIR hyperintensity, which on follow up after 2 weeks showed mild resolution of findings in form of size and intensity with no restricted diffusion. There was a total of 19 patients (73.0%) who had bilateral findings on MRI, out of whom symmetricity was seen in only 7(36.8%) with asymmetric involvement in 12 patients (63.15%).

MRI findings were scored according to the region of involvement with one score representing one region of one side. The most frequent score was 1 seen in 6 patients (23.1%) with the next frequent score being 4 area involvement seen in 5 patients (19.2%). The maximum score was 12 seen in 1 patient (3.8%) with a minimum score of 0 seen in 1 patient (3.8%). Compared to Equivocal cases the JE positive cases overall had higher area score as seen in Fig 2 and overall there was a higher area score in adults when compared to children as seen in Fig 3.

Fig 2: Number of radiologically involved sites/ score in JE Positive and Equivocal cases.

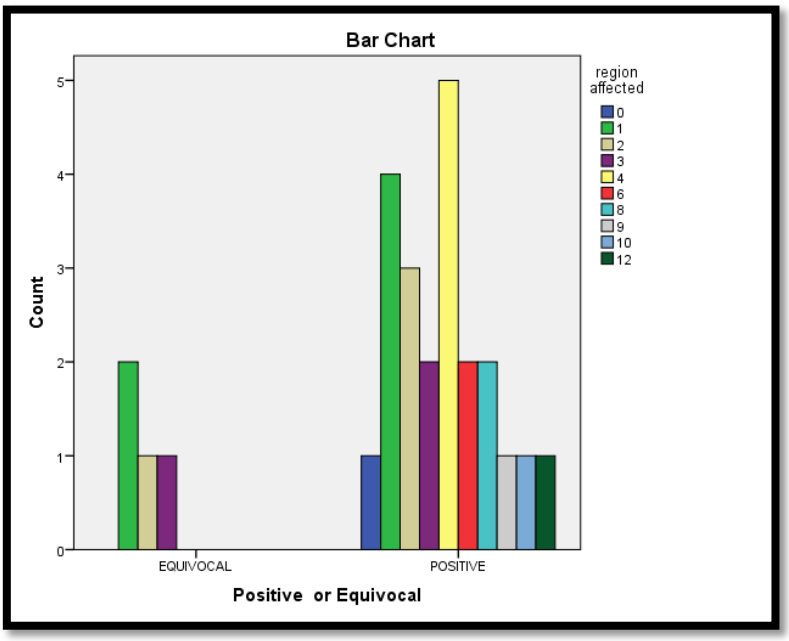
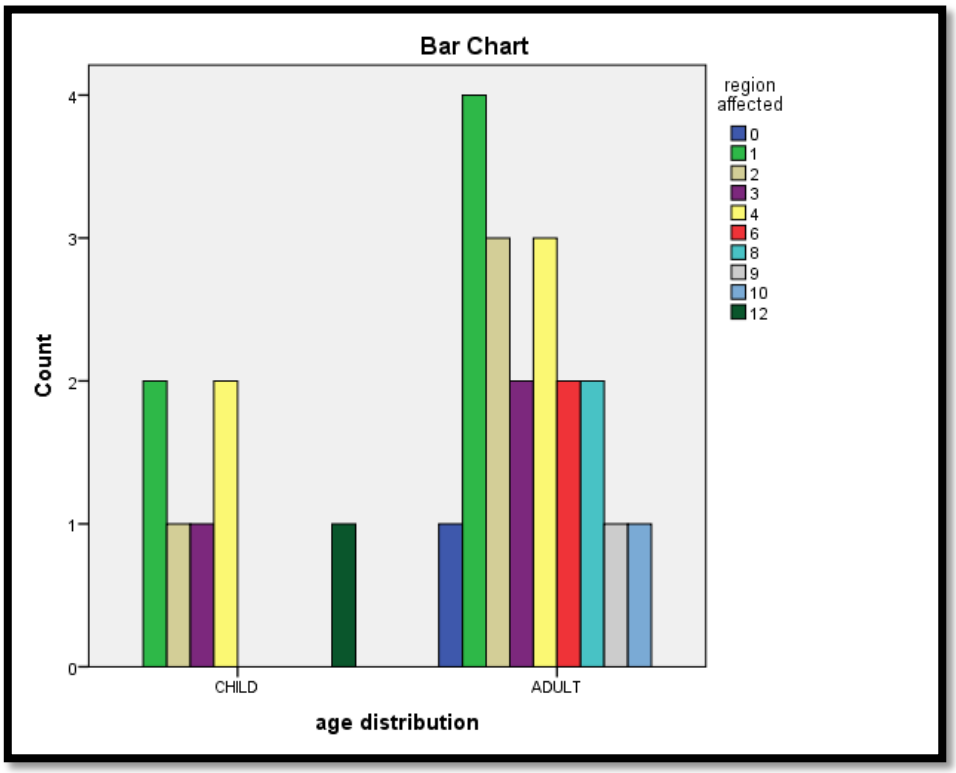


Fig 3: Number of radiologically involved sites/ scores in children and adults.



Among the JE equivocal case 4(15.3%) there were 2 cases (50%) with unilateral thalamic involvement, 1 case (25%) with bilateral thalamic and unilateral cortical involvement, 1 case (25%) with bilateral hippocampal involvement. None had involvement of lentiform nucleus, caudate involvement, substantia or brainstem lesion.

Summary of clinical and radiological findings according to adults vs children are given in Table 1.

Table 1. Summary of clinical and radiological findings according to adults vs children

	Adults (n, age distribution %) Total 19(73.0)	**Children (n, age distribution %) Total 7 (26.9)**	**Total (n, study population distribution %) Total 26(100)**
Clinical findings:			
Male: Female ratio	8:11(42.1:57.8)	3:4(42.8:57.1)	12:14(46.2:53.8)
Duration of illness	Acute 8 (66.7)	Acute 4 (33.3)	12(46.15)
	Subacute 11 (78.6)	Subacute 3 (21.4)	14(53.8)
	Chronic 0 (0)	Chronic 0 (0)	0(0)
Probable JE	1(5.2)	3(42.8))	4(15.3)
Positive JE	18(94.7)	4(57.1)	22(84.6)
Radiological findings:			
Thalamus	Unilateral 3(15.7)	Unilateral 3(42.8)	6(23.0)
	Bilateral 13(68.4)	Bilateral 2 (28.5)	15(57.6)
	Asymmetric 9(69.2% of 13)	*Asymmetric 1 (50% of 2)*	*10(38.4)*
	Symmetric 4(30.7 % of 13)	*Symmetric 1(50% of 2)*	*5(19.2)*
	Absent 3(15.7)	Absent 2(28.5)	5(19.2)
Lentiform nucleus	Unilateral 0(0)	Unilateral 1(14.2)	1(3.8)
	Bilateral 2(10.5)	Bilateral 1(14.2)	3(11.5)
	Asymmetric1(50)	*Asymmetric 1(100)*	*2(7.6)*
	Symmetric 1(50)	*Symmetric 0(0)*	*1(3.8)*
	Absent 17(89.4)	Absent 5(71.4)	22(84.6)
Caudate nucleus	Unilateral 1(5.2)	Unilateral 0(0)	1(3.8)
	Bilateral 3(15.7)	Bilateral 2(28.5)	5(19.2)
	Asymmetric 1(33.3)	Asymmetric 0(0)	1(3.8)
	Symmetric 2 (66.6)	Symmetric 2(100)	4(15.3)
	Absent 15 (78.9)	Absent 5 (71.4)	20 (76.9)
Cortical involvement	Unilateral 4 (21.0)	Unilateral 0 (0)	4(15.3)
	Bilateral 1(5.2)	Bilateral 1(14.2)	2(7.6)
	Asymmetric 1(100)	*Asymmetric 1(100)*	*2(7.6)*
	Symmetric 0(0)	*Symmetric 0(0)*	*0(0)*
	Absent 14(73.6)	Absent 6(85.7)	20(76.9)
Hippocampus	Unilateral 1(5.2)	Unilateral 0(0)	1(3.8)
	Bilateral 8(42.1)	Bilateral 4(57.1)	12(46.1)
	Asymmetric 6(75.0)	*Asymmetric 2(50.0)*	*8(30.7)*
	Symmetric 2(25.0)	*Symmetric 2(50.0)*	*4(15.3)*
	Absent 10(52.6)	Absent 3(42.8)	13(50.0)
Substantia nigra	Unilateral 1(5.2)	Unilateral 0(0)	1(3.8)
	Bilateral 7(36.8)	Bilateral 1(14.3)	8(3.07)
	Asymmetric 4(57.1)	Asymmetric 0	4(15.3)
	Symmetric 3(42.8)	*Symmetric 1(100)*	*4(15.3)*
	Absent 11(57.8)	*Absent 6(85.7)*	*17(65.3)*
Others	Absent 19(100)	Splenial lesion 1(14.2)	1(3.8)
Area Involvement Score (Max,Min)	12, 0	4, 1	12, 0
DWI/ADC	Nil restriction/Low ADC	Nil restriction/Low ADC	Nil restriction/Low ADC

VI. Discussion:

Post infection by a JEV there is a period of viremia that is usually brief and titers are also low, humans are considered as a dead-end host and most infections are therefore asymptomatic with few of the infections progressing to clinically acute encephalitis.[7] In newly endemic areas, both adults and children are equally affected whereas in areas where JE infection has been endemic for several years, mainly children are affected when compared to adults, owing to herd immunity.[8] In our study, there were seven children constituting only 26.9% of the study population, which may be due to referral bias or even due to the high prevalence of JE vaccination of children in the known endemic area. It was also observed in one study among children with JE, that 80.5% of the symptomatic children were not vaccinated.[9] The neurotropic JE virus has a special predilection for specific areas of the central nervous system and the documented susceptible areas being bilateral thalami, basal ganglia, substantia nigra, cerebral cortices and cerebellum along with anterior horns of the spinal cord which occurs after an initial phase of viremia.[5,6,10,11] These findings help differentiate JE from other equally prevalent causative aetiology of AEV like HSV, where there is temporal lobe predilection with some studies describing necrosis as a hallmark of Herpes Simplex Encephalitis (HSE)[12,13] In our study there was a predominance of asymmetric distribution of signal abnormalities (63.5%) in patients having bilateral thalamic, basal ganglia, brainstem, substantia nigra, hippocampal and cortical involvement. This is atypical of the classically described bilateral symmetrical involvement especially of the thalamus, basal ganglia, and substantia nigra. Similar observations of asymmetric involvement have been noted in one study.[14]None of the lesions in our study revealed restricted diffusion and corresponding low ADC value to suggest cytotoxic edema, in patients presenting up to the subacute stage of the disease, which was also seen in one study where the lesions

demonstrated no restricted diffusion in acute stage and later demonstrated high average ADC value in chronic stage due to facilitated diffusion.[12] However none of the patient in our study presented in chronic phase of the disease. We observed splenial signal abnormality in one of the JE positive children, who did not present with seizure nor with any abnormal biochemical study to explain other causes of splenial signal abnormality. Similar splenial involvement has also been described in three cases of JE, all however involving adults.[14,15]It has been shown that seizure development is closely related to the involvement of the cortex.[16] Seizures were noted in only two of our patients, and both of them had involvement of the cortex in more than one region, however, the rest of the four patients with cortical involvement did not inversely have symptoms of seizure. There was significant hippocampal involvement in 50% of the patients with predominant bilateral involvement. Some involving up to the tail of the hippocampus and some extending to the amygdala region. Hippocampal involvement in JE has also been described in some studies, although it was not a previously recognized classical site of involvement in JE.[17,18] One adult male patient was found to be positive for both JE and Dengue IgM. He was from one of the districts with maximum case reports in the recent outbreak of JE and the rest of his blood parameters were normal including platelets. His MRI findings were typical of JE in the form of bilateral thalamic, substantia nigra and cortical hyperintensities in the setting of AEV. There is a phenomenon of cross-reactivity of these culprit viruses which belong to the same Flaviviridae family and this causes a diagnostic dilemma, especially when the possibility of a co-existing disease occurs in an endemic region.[19] Some studies have tabulated characteristics to help differentiate these two disease entities. JE is noted to be more common in the post-monsoon season i.e, from June to September showing a high association with living in rural areas predominantly in areas where there are paddy cultivation, pig farming, and mosquito breeding.[20] Whereas dengue is more common in the urban regions where mosquito breeding is mainly contributed by stagnant water in empty cans, rooftop, craters, etc. Hence, in the set-up of an outbreak of Japanese Encephalitis and classical signs of bilateral thalamic and basal ganglia involvement, JE was considered more likely, although further lab investigation like PCR could not be carried out. Some studies have demonstrated occasional hemorrhagic lesions in bilateral basal ganglia in JE patients, while this finding is also described in cases of Dengue encephalitis. Hence, attention has to be made in regards to differentiating these two entities especially when there is a presence of cross-reactivity of the IgM tests results, to initiate an appropriate line of management and look out for clinical complications which are of a different spectrum between the two diseases to reduce morbidity and mortality. We, however, did not come across hemorrhagic lesions in our study although it has been documented infrequently. It has been shown that JE lesions did not enhance on contrast administration either in CT or in MRI.[21,22] No contrast-enhanced MRI study was performed for our JE patients. There was no death reported among our study population, which may be due to less involvement of the brain stem, which has been attributed as one of the causes of morbidity of the JE.[12]

The role of imaging is not only to identify the presence of an abnormality but also help in early diagnosis and treatment of Japanese Encephalitis. MRI has shown to be superior to computed tomography (CT) in picking up abnormalities and demonstrating the region of involvement, severity, and extent of neuroparenchymal abnormality especially with the T2W and T2 FLAIR sequences which can detect abnormalities within 48hrs.[23,24] In our study among the sequences, T2 FLAIR was the most sensitive in picking up the signal abnormality especially in the acute phases where the signal changes were subtle. This was similar to observations in previous studies.[12] The earliest time of signal abnormality picked up in our study, was by the fourth day of onset of symptoms.None of our patients had cerebellar lesions, hydrocephalus, cerebral venous sinus thrombosis, and hemorrhage as described in previous case reports. [25,26,27]

Fig 4:T2-FLAIR axial image showing bilateral asymmetric thalamic signal abnormality

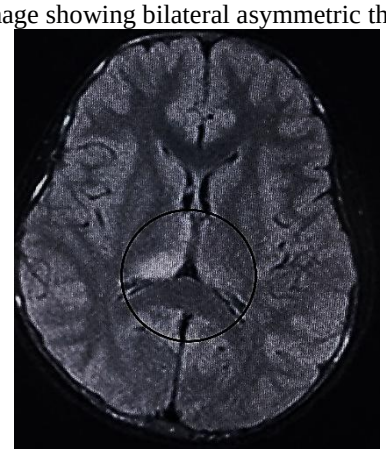


Fig 5:T2-FLAIR axial image showing unilateral left hippocampal hyperintense signal

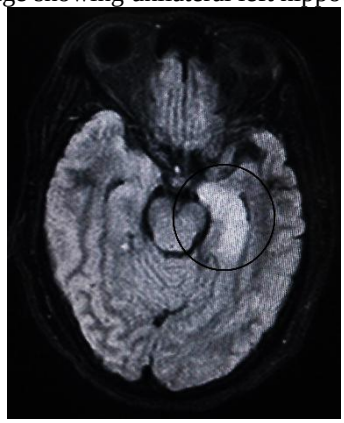


Fig 6(A):T2-FLAIR axial image showing hyperintense signal in the splenium
Fig 6(B):T2W axial image on 3 weeks follow up showing residual hyperintense signal in splenium

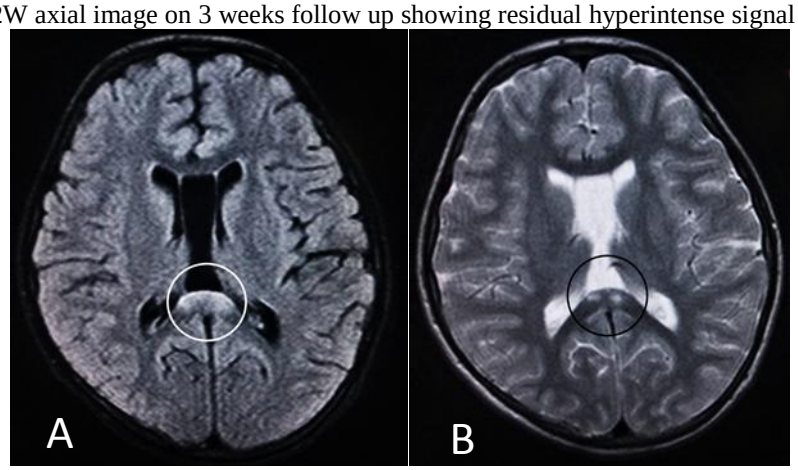


Fig 7(A):T1W axial image showing bilateral symmetric thalamic hypointense signal
Fig 7(B):T2W axial image in same patient with corresponding bilateral symmetric thalamic hyperintense signal

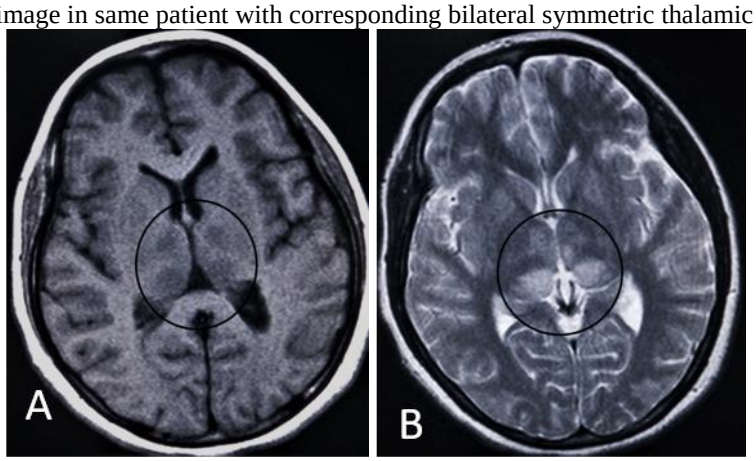


Fig 8:T2-FLAIR axial image showing asymmetric right temporal and left parietal cortical, bilateral thalamic and caudate nucleus hyperintense signals

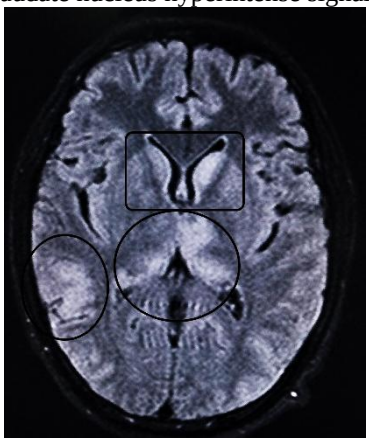
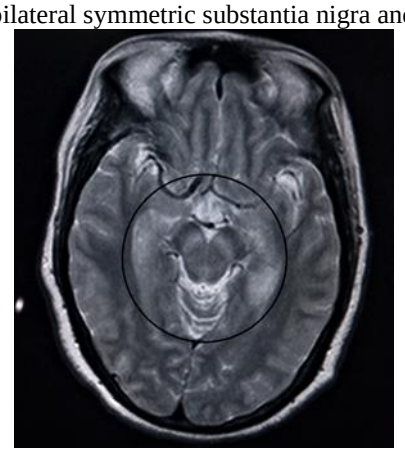


Fig 9:T2W axial image showing bilateral symmetric substantia nigra and hippocampal hyperintense signal



VII. Summary and conclusion:

Post primary infection with JEV, a rapid and potent monotypic IgM response occurs in serum and cerebrospinal fluid (CSF) usually within 7 days which is the basis of ELISA detection.Prior to this the serum or CSF IgM ELISA test for JE can be falsely negative or equivocal. Hence MRI plays an important role in detecting signal abnormalities within four days of the disease onset, so that appropriate supportive treatment is provided, to avoid delayed diagnosis and unwanted morbidity and mortality. Awareness should be made, about lesser described predominant involvement of the hippocampus in JE, which in our study was 49.9%, to avoid misinterpretation for other causes of medial temporal lobe signal abnormalities. The asymmetric distribution of lesions in bilateral involvement of thalami, basal ganglia and substantia nigra could initially present as unilateral involvement and high suspicion for JE involvement needs to be considered especially in a setting of JE outbreak.

VIII. Limitations:

Our study was a retrospective study and due to this, the study population did not include all patients who were diagnosed with JE and may not be representative of the entire population along with referral bias, although clinically symptomatic patients were included. Due to the small sample size, we were not able to demonstrate a statistically significant correlation between the different clinical and radiological parameters.

Conflicts Of Interest: Nil
Acknowledgment: Nil

References:

[1]. Solomon T, Thao TT, Lewthwaite P, Ooi MH, Kneen R, Dung NM et al. A cohort study to assess the new WHO Japanese Encephalitis surveillance standards. Bulletin of the World Health Organization 2008;86:178–186.
[2]. Dutta P, Khan A, Khan AM, Borah J, Sarmah CK, Mahanta J. The effect of Insecticide-Treated Mosquito Nets (ITMNs) on Japanese encephalitis virus seroconversion in pigs and humans. American Journal of Tropical Medicine and Hygiene 2011;84:466-72.
[3]. RodhainF.Recent data on the epidemiology of Japanese encephalitis. Bull Acad Natl Med 1996;180(6):1325-37.

[4]. Verma R.MRI features of Japanese encephalitis.BMJ Case Reports 2012;
[5]. Kumar S, Misra UK, Kalita J, Salwani V, Gupta RK, Gujral R. MRI in Japanese encephalitis. Neuroradiology 1997;39:180–4.
[6]. Shoji H, Kida H, Hino H, Matsuura S, Kojima K, Abe T, et al. Magnetic resonance imaging findings in Japanese encephalitis, white matter lesions. J Neuroimaging 1994;4(4):206–11.
[7]. Solomon T, Dung NM, Kneen R, Gainsborough M, Vaughn DW, Khanh VT. Japanese Encephalitis. J NeurolNeurosurg Psychiatry 2000;68:405-15.
[8]. Kalita J, Misra UK, Pandey S,Dhole TN.A comparison of clinical and radiological findings in adults and children with Japanese encephalitis. Arch Neurol2003;60:1760-4.
[9]. Kakoti G, Dutta P,Das BR, Borah J, Mahanta J.Clinical profile and outcome of Japanese Encehalitis in children admitted with acute encephalitis syndrome.BioMed Research International 2013; Article ID 152656;5 pages.
[10]. Tiroumourougane SV, Raghava P, Srinivasan S. Japanese Viral Encephalitis. Postgrad Med J 2002;78:205-15.
[11]. Misra UK, Kalita J, Jain SK, Mathur A. Radiological and neurophysiological changes in Japanese encephalitis. J NeurolNeurosurg Psychiatry 1994;57:1484-7.
[12]. Uphadhyay RK. Biomarkers in Japanese Encephalitis. BioMed Research International 2013;Article ID 591290;1-24.
[13]. Sawlani V. Diffusion-weighted imaging and apparent diffusion coefficient evaluation of herpes simplex encephalitis and Japanese encephalitis. Journal of the Neurological Sciences 2009;287:221-6.
[14]. Man BL, FU YP. The first case of mild encephalopathy with reversible splenial lesion due to Japanese encephalitis virus infection.BMJ Case Rep 2013;2013:bcr2013200988. Published 2013 Oct 17.doi:10.1136/bcr-2013-200988
[15]. Singh P, Gogoi D, Vyas S, Khandelwal N. Transient splenial lesion: Further experience with two cases. IJRI 2010;4:254-7.
[16]. Misra UK, Kalita J. Seizures in Japanese encephalitis.J Neurol. Sci 2001;190:57-60.
[17]. Handique SK, Das RR, Barman K, Medhi N, Saharia B, Saikia P et al. Temporal lobe involvement in Japanese Encephalitis: Problems in Differential Diagnosis. Am J Neuroradiol2006;27:1027-31.
[18]. Basumatary LJ, Raja D, Bhuyan D, Das M, Gowswami M, Kayal AK. Clinical and radiological spectrum of Japanese encephalitis. Journal of the Neurological Sciences 2013;325:15-21.
[19]. Innis BL, Nisalak A, Nimmannitya S, Kusalerdchariya S, Chongswasdi V, Suntayakorn S, et al. An enzyme-linked immunosorbent assay to characterize dengue infections where dengue and Japanese encephalitis co-circulate. Am J Trop Med Hyg1989 ;40:418-27.
[20]. Kalita J, Misra UK. Neurophysiological changes in Japanese Encephalitis. Neurol India 2002;50:262-66
[21]. Shoji H, Kin Y, Fujimoto H, KusuharaT,Matsuishi T. Japanese encephalitis.ClinNeurosci 1998;15:75-7.
[22]. Shoji H,Hiraki Y, Nuwasaki N, Toyomasu T, Kaji M, Okudera T. Japanese encephalitis in the Kurume region of Japan:CT and MRI findings.JNeurol 1989;236:255-9.
[23]. Misra UK, KalitaJ,Jain SK, Mathur A.Radiological and neurolophysiological changes in Japanese encephalitis. J NeurolNeurosurg Psychiatry 1994;57:1484-7.
[24]. Maschke M, Kastrup O, Forsting M, Diener HC. Update on neuroimaging in infectious central nervous system disease. Curr.Opin.Neurol 2004;17:475-80.
[25]. Jia M, Xiong N, Huang J, Wang Y, Zhang X, Zhang Z et al. Japanese Encephalitis accompanied by cerebral venous sinus thrombosis:a case report. BMC Neurology 2012;12:43.
[26]. Suman V, Roy U, Panwar A, Raizada A. Japanese Encephalitis complicated with obstructive hydrocephalus. Journal of Clinical and Diagnostic Research 2016;10:18-20.
[27]. Kalita J, Misra UK. Comparison of CT scan and MRI findings in the diagnosis of Japanese Encephalitis.Journal of the Neurological Science 2000;174:3-8.

Dr. Esther L.Pachuau, et.al. "MRI Brain Evaluation in a Recent Outbreak of Japanese Encephalitis with Clinico-Radiological Correlation." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(1), 2020, pp. 37-46.