Section: Radiodiagnosis

Original Research Article

SPECTRUM OF MRI FINDINGS IN ACUTE ENCEPHALITIC SYNDROME IN EASTERN PART OF UTTAR PRADESH

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Received : 17/04/2023
Received in revised form : 12/05/2023
Accepted : 26/05/2023

Keywords:
Acute encephalitic syndrome, Japanese encephalitis, herpes simplex encephalitis, Magnetic Resonance Imaging.

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DOI: 10.47009/jamp.2023.5.3.259

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (3); 1271-1276

Abstract

Background: Acute encephalitic syndrome (AES) is characterized as acute onset of fever and a change in mental status (mental confusion, disorientation, delirium, coma) and / or new onset of seizure any time of the year, in a person of any age. The objective is to assess patterns of brain involvement in MRI in patients with acute encephalitis syndrome and to correlate with radiological diagnosis (MRI) with clinical and laboratory data. **Materials and Methods:** This cross sectional study was conducted on patients from OPD/IPD and from AES unit on all patients full filling the standard WHO case definition of AES in Nehru hospital, Baba Raghav Das medical college. MRI findings were assessed for involvement of cerebral hemispheres and involvement of limbic system, posterior fossa. Clinical details were obtained from the request form for MRI brain. File records were also traced and reviewed for clinical details, laboratory findings including serology, CSF study, outcome and discharge. **Result:** The majority of individuals with limited diffusion had edema as part of their MRI results for encephalitis. Herpes encephalitis often showed involvement of the medial temporal lobe and the thalamus, with sparing of the basal ganglia, which made it easier to identify from infarction of the middle cerebral artery. In Japanese encephalitis, bilateral thalamic and basal ganglia involvement was more frequent. In scrub typhus encephalitis showed subcortical white matter lesions, with area of cortical involvement, microhemorrhage on susceptibility weighted imaging, diffusion restriction in white matter lesions. No contrast enhancement was seen. Involvement of the posterior fossa was also prevalent in our sample, suggesting a non-traditional etiological agent. **Conclusion:** AES is a major cause of morbidity & mortality in India. A reduction in morbidity and mortality may be the consequence of following proper treatment protocols. Appropriate national Health Program on AES, especially vector control is needed for further betterment. JE can be prevented by vaccination. Proper advertisement in mass media may be helpful.

INTRODUCTION

Acute encephalitic syndrome (AES) is characterized as acute onset of fever and a change in mental status (mental confusion, disorientation, delirium, coma) and / or new onset of seizure any time of the year, in a person of any age.[1]

The incidence of AES cases in UP have declined from 18.2 per million population during 2005-2009 to 15 per million population during 2015-2019 and case fatality rate (CFR) reduced from 33% during 1980-1984 to 12.6% during 2015-2019. This decline

ISSN (O): 2687-5365; ISSN (P): 2753-6556

was likely due to active surveillance programs identifying etiological agents and risk factors of AES cases. The identified etiologies of AES include Japanese encephalitis virus (5–20%), Enterovirus (0.1–33%), Orientia tsutsugamushi (45–60%) and other viral (0.2–4.2%), bacterial (0–5%) and Rickettsial (0.5–2%) causes.[4]

The disease most commonly affect children and young adult and lead to considerable morbidity and mortality, mortality depend on a number of factors, including the severity of disease and age.[2]

According to estimates, pediatric encephalitis poses a 13% chance of fatality and a 78% chance of neurological sequelae throughout the follow-up period of one to five years.[4] A few of studies reporting the degree of disability using both standardized performance methods and at least 1 year of follow-up after hospital dis-charge, the rate of moderate or severe disability affecting school performance or causing dependence has been re-ported as 13% to 33%.[10]

Neuroimaging findings in childhood encephalitis differ from adults, and range from normal magnetic resonance imaging (MRI) to severe hemorrhagic/necrotizing lesions and brain edema. The association between abnormal brain MRI findings with severe clinical presentation and short-term outcome of encephalitis has been reported. The length of hospitalization is also inversely associated to the severity of brain MRI results. Abnormal brain MRI, parenchymal involvement regions with diffusion restriction, and localized cortical abnormalities on brain MRI are all linked to poor long-term outcomes. Other risk factors, such as young age microbial etiology (especially herpes simplex virus) recurrent seizures and need for intensive care unit (ICU) or ventilator therapy are also associated with poor outcome.[6]

MATERIALS AND METHODS

This cross-sectional study was conducted on patients from OPD/IPD and from AES unit on all patients full filling the standard WHO case definition of AES in Nehru hospital, Baba Raghav Das medical college. Patients with metallic implants, contrast allergy, claustrophobia, cardiac pacemaker, neurostimulator. Patients with bacterial, tubercular, fungal meningitis, brain tumor were excluded from the study.

MRI findings suggestive of cerebrovascular events (ischemia or hemorrhagic stroke) were excluded from the study.

MRI findings were assessed for involvement of cerebral hemispheres and involvement of limbic system including insular cortex, subcortical grey matter including basal ganglia and thalamus, posterior fossa including cerebellar hemisphere, brain stem.

Diffusion weighted images were assessed for presence of restriction. Susceptibility weighted images were assessed for presence blooming for hemorrhage/ blood products or calcium.

Clinical details were obtained from the request form for MRI brain.

File records were also traced and reviewed for clinical details, laboratory findings including serology, CSF study, outcome and discharge.

Data were entered in a predesigned proforma, entered in Microsoft Excel Spreadsheet and analyzed.

RESULTS

A total of 71 MRI which met the inclusion criteria were incorporated in the study.

The group consisted of both the pediatric (53; 74.7%) and adult population (18; 25.3%) with mean age of 15.45±14.88years.

The age ranged from 2 years to 65years with median of 11years(Interquartile range 4-20 years). Females were higher than males with male to female ratio of 1:2.9

Majority of them belonged to lower (88.7%) and lower middle (11.3%) socioeconomic status according to modified BG Prasad scale. Among study subjects (71.8%) were from rural population.

Fever (64; 90.1%) and altered sensorium (65; 91.5%) were two most common clinical pictures among them 9(12.7%) patients were presented with confusion/delirium followed by obtundation 6 (8.5%). [Table 1]. Seizure was present in 19 (26.8%) patients.

In 22(15.5%) patients, cranial nerve palsy was In 11(15.5%) patients, cranial nerve palsy was present, among them facial nerve palsy was most common 9(83%). Motor weakness was present among 6(8.5%) of study population, among them paraparesis being most common 3 (53%). In 10(14.1%) of patients, tone disturbance was noted & dystonia was most common clinical finding among them. Bleeding manifestation is noted among 2(3%) children. Focal signs were rare and seen in only 8 (11.3%) cases.

50 (70.4%) of the patient had showed cerebral hemisphere Involvement. Temporal lobe involvement was seen in all cases with cerebral hemisphereinvolvement. In 36 (50.7%) cases, the involvement was bilateral. In 16 (22.5%) cases, insular cortex involvement was seen.In 12(16.9%), frontal lobe involvement was seen. In 2(2.8%) patients, parietal lobe involvement was seen. In 24(33.8%) patients, basal ganglia involvement was seen. In 28 (39.4) patients, thalamic involvement was seen. In 11 (15.7%) patients, basal ganglia involvement was seen in associationwith cerebral hemisphere involvement(Table 2). In 16 (22.8%) patients, thalamus involvement association with cerebral hemisphere involvement was seen. In 21(29.6%) patients, posterior fossa involvement was seen.In 8(11.3%) patients, brainstem was seen to be involved. In 4(5.6%) patients cerebellum was seen to be involved. In 4(5.6%) patients, cerebral

ISSN (O): 2687-5365; ISSN (P): 2753-6556

peduncles was seen to be involved. Japanese encephalitis was reported in 16 (22.5%) cases. Bilateral substantia nigra involvement was observed in 12 patients (77%). Caudate nuclei involvement was observed in 6 patients (38%), bilaterally symmetrical in 2 patients (12%), bilaterally asymmetrical in 2 patients (12%), and unilateral in 2 patients (12%). Lentiform nuclei involvement was observed in 8 patients (50%), bilaterally asymmetrical in 15 patients (27.8%), bilaterally symmetrical in 4 patients. (7.4%), and unilateral in 10 patients (18.5%). Cerebral cortex involvement was observed in 6 patients (37%), with single cerebral hemispheric involvement observed in 3 patients (21%), bilateral cerebral hemispheric involvement in 2 patients (12%)

Cerebral cortex involvement in more than one lobe of the cerebral hemisphere was observed in 2 patients (14%). On SWI, thalamic microbleeds were observed in 3 JE patients (2%) Herpes was the etiology in 15 (21.1%) cases MRI was characteristic with involvement of medial temporal lobes in all cases. In 3 (22%) cases, insular cortex involvement was seen, In (22%) patients, basal ganglia involvement was seen. In 6 (39.4) patients, thalamic involvement was seen.. Involvement was asymmetric and bilateral in 6(42%) patients and unilateral in 8(56%) patients

7(9.9%) of cases with positive serology for Scrub typhus was noted. Japanese encephalitis was reported in 16 (22.5%) cases. Herpes was the etiology in 15 (21.1%) cases. In 33 cases etiology could not be determined (Table 4).

Table 1: Presenting symptoms in study subjects (n=71)

Presenting symptoms	No.	%
Fever	64	90.1%
Altered mental status	65	91.5%
Seizure	19	26.8%
Confusion/Delirium	9	12.7%
Obtundation	6	8.5%
Bleeding manifestations	2	2.8%

Table 2: MRI character in acute encephalitis study subjects (n=71)

MRI character	No.	%
T1 low, T2 and FLAIR Hyperintensity	66	93%
Restriction on DWI	64	90.1%
Haemorrhage (blooming on SWI)	2	2.8%

Table 3: MRI finding in acute encephalitis study subjects (n=71)

MRI finding	No.	%
Cerebral hemisphere	50	70.4
Temporal lobe	36	50.7
Fronto-temporal lobe	12	16.9
Temporal and parietal lobes	2	2.8
Deep gray matter		
Basal ganglia	24	33.8
Insular cortex	16	22.5
Thalamus	28	39.4
Posterior fossa	21	29.6
Brainstem	8	11.3
Cerebral peduncle	4	5.6
Cerebellum	4	5.6
Brain stem & cerebral peduncle	4	5.6

Table 4: Serology report in study subjects (n=71)

Serology report	No.	%
Japanese encephalitis	16	22.5
Scrub typhus	7	9.9
Other	33	46.4
Herpes	15	21.1

ISSN (O): 2687-5365; ISSN (P): 2753-6556

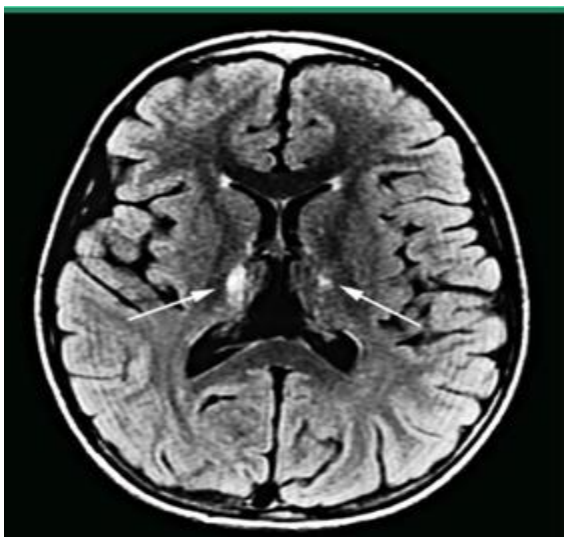

Figure 1: Axial T2 weighted Flair Image showing bilateral asymmetrical thalamic hyperintensities in the patient of Japanese encephalitis (Arrows).

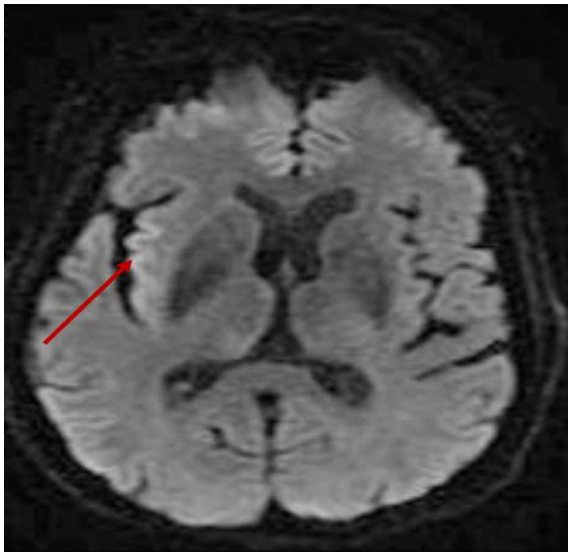

Figure 2: Restriction diffusion on DWI in right insular cortex in the patient of herpes simplex encephalitis.

DISCUSSION

Being infective condition, acute encephalitis syndrome is common in extremes of ages and pediatric population than in adults.

In Our study, A total of 71 MRI which met the inclusion criteria were incorporated in thestudy.

The group consisted of both the pediatric (53; 74.7%) and adult population(18; 25.3%) with mean age of 15.45±14.88years.

The age ranged from 2 years to 65years with median of 11years(Interquartile range 4-20 years). Mean age was 15.45±14.88 years. Median age was 11 (4-20) years. Range was 2-65 years. Females were higher than males with male to female ratio of 1:2.9. Similarly in Songmen S, et 2015**,**[2] among sample size of 47 the group consisted of both the pediatric(11; 23.40%) and adult population (36; 76.59%) with mean age of 33.00±18.61 years. The age ranged from 8 years to 82 years with median of 32 years (Interquartile range 32). Males and females constitute almost equal proportion with female to male ratio of 1:1.24. Likewise in the study of Mrinal Kanti Ghosh et al, 2017,[3] Among 628 children 62.1% were boys & 70.4% were from rural population.

Mrinal Kanti Ghosh et al, 2017,[3] Majority of them belonged to lower socioeconomic status according do modified BG Prasad scale. Similarly, in our study Majority of them belonged to lower socioeconomic status according to modified BG Prasad scale.

In the study of Mrinal Kanti Ghosh et al., 2017, ,[3] Among 628 children Majority of them presented with fever between 100°F-102°F (76.0%). Cranial nerve palsy was found among 16.2 % children, among them facial nerve palsy was most common (86.1%). Motor weakness was present among 11.3 % of study population, paraparesis being most common (59.2%). Tone disturbance was noted among 19.7 % children with AES & dystonia was most common clinical finding among them. Further according to Songmen S et al, 2017, [2]Fever (42; 89.4%) and altered sensorium (43; 91.5%) were two most common clinical presentations. Seizure was present in 10 (21.3%) patients while focal signs were rare and seen in only 4(8.3%) cases. Similar to Mrinal Kanti Ghosh et al, 2017,[3] Songmen S et al, 2017, [2]in the our study fever (64; 90.1%) and altered sensorium (65; 91.5%) were two most common clinical pictures among them 9(13%) patients was presented with confusion/delirium followed by obtundation 6 (8%). Seizure was present in 19 (26.8%) patients. In 11(15.5%) patients, cranial nerve palsy was present, among them facial nerve palsy was most common 9(83%). Motor weakness was present among 6(8.5%) of study population, among them paraparesis being most common 3 (53%). In 10(14.1%) of patients, tone disturbance was noted & dystonia was most common clinical finding among them. Bleeding manifestation is noted among 2(3%) children.

As per findings of Mrinal Kanti Ghosh et al**, 2017,** [3]sample size of 642 children, COMMON radiological findings included basal ganglia involvement (16.1%), cortical involvement (14.5%), white matter involvement (13.1%), Cerebellar involvement was least common (1.3%). Nearly similar, in the present study, 11 (15.7%) patients had basal ganglia involvement in association with cerebral hemisphere involvement, In 24(33.8%) patients had basal ganglia involvement. In 4(5.6%) patients had cerebellum involvement.

According to Songmen S et al, 2015,[2] out of 47patients, Involvement of cerebral hemisphere was seen in 34(72.3%). Temporal lobe involvement was seen in all cases with cerebral hemisphere involvement. In 25(53.19%) cases, the involvement was bilateral. Insular cortex involvement was seen in 10(21.3%) cases. Frontal lobe involvement was seen in 8(17%) and parietal lobe involvement was

ISSN (O): 2687-5365; ISSN (P): 2753-6556

seen in 1(2.1%) patients. Basal ganglia involvement was seen in 15(31.9%) patients, and thalamic involvement was seen in 18(38.3) patients. In 6 (12.77%) patients, basal ganglia involvement was seen in association with cerebral hemisphere involvement and involvement of thalamus in association with cerebral hemisphere involvement was seen in 10(21.28%) patients. Posterior fossa involvement was seen in 14(29.8%) patients. Brainstem was seen to be involved in 10(21.28%), cerebellum in 4(8.6%) and cerebral peduncles in 5(10.7**%).** Similarly in the current study 50 (70.4%) of the patient had showed cerebral hemisphere Involvement. Temporal lobe involvement was seen in all cases with cerebral hemisphereinvolvement. In 36 (50.7%) cases, the involvement was bilateral. In 16 (22.5%) cases, insular cortex involvement was seen.In 12(16.9%), frontal lobe involvement was seen. In 2(2.8%) patients, parietal lobe involvement was seen. In 24(33.8%) patients, basal ganglia involvement was seen. In 28 (39.4) patients, thalamic involvement was seen. In 11 (15.7%) patients, basal ganglia involvement was seen in associationwith cerebral hemisphere involvement. In 16(22.8%) patients, thalamus involvement in association with cerebralhemisphere involvement was seen. In 21(29.6%) patients, posterior fossa involvement was seen. In 8(11.3%) patients, brainstem was seen to be involved. In 4(5.6%) patients cerebellum was seen to be involved. In 4(5.6%) patients, cerebral peduncles was seen to be involved.

According to Pranjal Phukan et al, 2021,[8] 54 JE patients of study, T2WI and FLAIR thalamic hyperintensities were demonstrated in 53 patients (98.1%), bilaterally asymmetrical in 48 patients (88.9%), bilaterally symmetrical in 4 patients (7.4%), and unilateral in another 1 patient. Bilateral substantia nigra involvement was observed in 44 patients (81.5%). Caudate nuclei involvement was observed in 22 patients (40.7%), bilaterally symmetrical in 8 patients (14.8%), bilaterally asymmetrical in 8patients (14.8%), and unilateral in 6 patients (11.1%). Lentiform nuclei involvement was observed in 29 patients (53.7%), bilaterally asymmetrical in 15 patients (27.8%), bilaterally symmetrical in 4 patients (7.4%), and unilateral in 10 patients (18.5%). Cerebral cortex involvement was observed in 29 patients (53.7%), with single cerebral hemispheric involvement observed in 13 patients (24.1%) and bilateral cerebral hemispheric involvement in 8 patients (14.8%). Cerebral cortex involvement in more than one lobe of the cerebral hemisphere was observed in 9 patients (16.7%) On SWI, thalamic microbleeds were observed in 2 JE patients (3.7%). Nearly similar, in the our study, Japanese encephalitis was reported in 16 (22.5%) cases.Thalamic hyperintensities were seen in 67 patients (94%). Bilateral substantia nigra involvement was observed in 12 patients (77%). Caudate nuclei involvement was observed in 6 patients (38%), bilaterally symmetrical in 2 patients (12%), bilaterally asymmetrical in 2 patients (12%), and unilateral in 2 patients (12%). Lentiform nuclei involvement was observed in 8 patients (50%), bilaterally asymmetrical in 15 patients (27.8%), bilaterally symmetrical in 4 patients(7.4%), and unilateral in 10 patients (18.5%). Cerebral cortex involvement was observed in 6 patients (37%), with single cerebral hemispheric involvement observed in 3 patients (21%), bilateral cerebral hemispheric involvement in 2 patients (12%).Cerebral cortex involvement in more than one lobe of the cerebral hemisphere was observed in 2 patients (14%). On SWI, thalamic microbleeds were observed in 3 JE patients (2%).

According to Zafar Neyaz et al 2016,[9] in scrub typhus patient bilateral symmetrical hyperintensities were seen in the subcortical white matter with diffusion restriction, focal area of cortical T2-weighted/fluid-attenuated inversion recovery hyperintensity was noted in the right frontal opercular region with foci of blooming on susceptibility-weighted images suggestive of microhemorrhage. Near similar in our study subcortical white matter lesions, with are of cortical involvement were seen, microhemorrhage were detected on susceptibility weighted imaging, Diffusion restriction were seen in white matter lesions. No contrast enhancement was seen.

According to Songmen S et al 2017,[2] T1 low and T2 and FLAIR Hyperintensity in 46(97.9%), Restriction on DWI 44(93.6%), Hemorrhage1(2.1%.) of patient were seen. Similarly in our study, T2 and FLAIR high signal intensity with low T1 signal intensity suggesting edema was seen in 66(93%) cases. Two (2.8%) of patient had hemorrhage with involvement of left medial temporal lobe with hemorrhage extending into lateral ventricle with associated hydrocephalus. Most of the MRI showed restriction in diffusion weighted imaging 64(90.1%)

CONCLUSION

The MRI findings in encephalitis constituted of edema in majority of patients with restricted diffusion. Medial temporal lobe involvement was predominant pattern in Herpes encephalitis and thalamus, basal ganglia involvement was typically spared, helping to distinguish from middle cerebral artery infarct. Bilateral thalamic and basal ganglia involvement was more common in Japanese encephalitis. Although nonspecific but subcortical, periventricular, and deep white matter areas, microhemorrhage was more common in scrub typhus encephalitis. Posterior fossa involvement was also common in our study probably representing a non-conventional etiological agent. A reduction in morbidity and mortality may be the consequence of following proper treatment protocols. Appropriate national Health Program on AES, especially vector control is needed for further betterment.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Results were limited to a single tertiary care center, inadequate sample size according to statistics , a cross-sectional study reflects findings of a rural population. Further multi-centric studies should be conducted with case-control randomization and double-blind approach.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556