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Research Article

Analysis of Acute Encephalitis Syndrome in Paediatric Patients: Clinical Profile, Etiology and Outcomes in a Tertiary Care Hospital of Nuh, Haryana

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A B S T R A C T

Introduction:-Acute encephalitis syndrome (AES) is a major public health concern in India,particularly among the pediatric population. Understanding the clinical profile,etiological spectrum,and outcomes of AES in children is essential for timely diagnosis,targeted management,and effective public health interventions.This study aims to retrospectively analyze pediatric AES cases in a tertiary care center in Nuh,Haryana,to delineate their clinical presentation,causative agents,and treatment outcomes.

Methods:-This retrospective observational study was conducted in Department of Pediatrics at Shaheed Hasan Khan Mewati Government Medical College,Nuh, Haryana after obtaining ethical approval from Institutional ethical committee.Medical records of children aged 1 month to 14 years,admitted with a diagnosis of AES from August 2024 to February 2025,were reviewed.AES was defined according to the World Health Organization criteria.Information regarding demographic data,clinical features,laboratory parameters,neuroimaging findings,treatment modalities,and outcomes were collected.Frequency and percentage were used for data analysis.

Results :-A total of 75 pediatric patients with AES were included in the study.The majority were under 5 years of age (66.7%),with a male-to-female ratio of 1.14:1.Fever & altered sensorium were universal symptoms (100%),followed by seizures (90.7%) & vomiting (37.3%).Etiology was identified in 59 cases(78.7%),with scrub typhus (20%),pyogenic bacterial meningitis (16%),and viral encephalitis (9.3%) being the most common.CSF examination was performed in 68 patients,showing pleocytosis in 77.9%,elevated protein in 70.6%, and low glucose in 52.9%.Neuroimaging was performed in 45 patients,with cerebral oedema being the most common abnormality (46.7%).ICU admission was required in 74.7% of patients,and 33.3% required mechanical ventilation.Full recovery was observed in 33.3% of patients.

Conclusion:-Acute Encephalitis Syndrome in children presents with diverse clinical features and etiologies,with scrub typhus emerging as a leading identifiable cause in this region.Early recognition,prompt supportive care, and targeted therapy are critical to improving outcomes.

Keywords: Acute Encephalitis Syndrome, Paediatrics, Scrub Typhus, Outcomes, Meningoencephalitis, Haryana

Introduction

Acute Encephalitis Syndrome (AES) is a serious neurological condition characterised by an acute onset of fever and altered mental status, often accompanied by seizures, focal neurological deficits, and coma.1 It remains a significant public health concern, particularly in paediatric populations, due to its high morbidity and mortality rates.2 AES can be caused by various infectious agents, including viruses such as Japanese encephalitis virus,3 enterovirus, and Herpes simplex virus, bacteria, fungi, and non-infectious causes, such as autoimmune disorders and toxin exposures.

A retrospective study of AES in paediatric patients provides valuable insights into the epidemiological patterns, clinical presentation, laboratory findings, treatment outcomes, and prognostic factors associated with the disease. By analysing past cases, this study aims to improve early diagnosis, guide therapeutic interventions, and contribute to the development of preventive strategies.According to published studies,the incidence of long-term neurological sequelae in children with AES has been reported to be as high as 60−80%.4

This study focuses on reviewing hospital records of paediatric patients diagnosed with AES over a defined period, identifying trends in aetiology, risk factors, treatment responses, and outcomes. The findings may help enhance clinical management protocols and inform public health policies to reduce the burden of AES in children.

Methods

This retrospective observational study was conducted in the Department of Paediatrics at Shaheed Hasan Khan Mewati Government Medical College, Nuh, Haryana - a tertiary care hospital in a rural region of North India. The study involved a review of medical records of 75 children aged 1 month to 14 years who were admitted to the hospital with a clinical diagnosis of AES during the period from August 2024 to February 2025.

AES was defined based on the World Health Organization (WHO) criteria as the acute onset of fever with a change in mental status (including symptoms such as confusion, disorientation, coma, or inability to talk) and/ or new onset of seizures (excluding simple febrile seizures), in a child of any age and at any time of year.[5]

Data were extracted from hospital medical records using a predesigned data collection form. Information was collected on demographic details, clinical features at presentation, laboratory investigations, neuroimaging findings (when available), treatment administered, need for intensive care or mechanical ventilation, and outcomes at discharge.

Etiological categorisation was made based on clinical presentation supported by available diagnostic investigations. These included cerebrospinal fluid (CSF) analysis, complete blood counts, liver and renal function tests, serological tests for scrub typhus, dengue, leptospira, and enteric fever, malaria antigen testing, and neuroimaging (Computed Tomography (CT)/ Magnetic Resonance Imaging (MRI) brain) where indicated. Cases were classified as having a known aetiology only when laboratory confirmation or strong clinical-radiological correlation was available.

Outcomes were categorised as full recovery, minor neurological deficit, major neurological deficit, vegetative state, death, or referred.

Data were entered into Microsoft Excel and analysed using descriptive statistics. Categorical variables were expressed as frequencies and percentages.

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee [IEC No. EC/OA-06/2025] approval letter dated May 27, 2025.

Results

A total of 75 paediatric patients diagnosed with AES were included in this retrospective analysis conducted at a tertiary care hospital in Nuh, Haryana.

The majority of patients (66.7%, n = 50) were under 5 years of age, followed by 24% (n = 18) in the age group of 5−10 years, and 9.3% (n = 7) in the age group of 11−14 years (Figure 1). The majority of AES cases were observed in children under 5 years of age, highlighting a higher vulnerability in this age group.

The study population included 40 males (53.3%) and 35 females (46.7%), with a male-to-female ratio of 1.14:1 (Figure 2).

All patients (100%) presented with fever and altered sensorium. Seizures were observed in 68 patients (90.7%). Other presenting symptoms included vomiting in 28 patients (37.3%), respiratory signs in 15 (20%), rash in 13 (17.3%) and focal neurological deficit in 10 (13.3%). Less common symptoms were headache in 6 patients (8%), coagulopathy in 6 (8%), generalised swelling in 5 (6.7%), involuntary movements in 5 (6.7%), irrelevant talk in 2 (2.7%) and a variety of signs such as neck stiffness and behavioural disturbances in 16 patients (21.3%) (Table 1 and Figure 3).

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Etiological diagnosis was established in the majority of cases. The most common cause identified was scrub typhus meningoencephalitis in 15 patients (20%), followed by pyogenic bacterial meningitis in 12 patients (16%) and meningoencephalitis of mixed aetiology in 7 patients (9.3%). Viral encephalitis was diagnosed in 7 patients (9.3%), while tubercular meningitis was seen in 6 patients (8%). Other identified aetiologies included acute disseminated encephalomyelitis (ADEM) in 3 patients (4%), enteric encephalopathy in 3 (4%) patients, leptospirosis and dengue encephalitis in 2 patients each (2.7%), and one case each (1.3%) of cerebral malaria and hepatic encephalopathy. Despite thorough evaluation, the aetiology remained undetermined in 16 patients (21.3%) (Table 2 and Figure 4).

CSF: Cerebrospinal Fluid

CSF analysis was performed in 68 out of 75 patients (90.6%). Pleocytosis was observed in 53 patients (77.9%), with lymphocytic predominance in 42 cases and neutrophilic predominance in 11 cases. Elevated CSF protein levels were noted in 48 patients (70.6%), and low CSF glucose levels were found in 36 patients (52.9%) (Table 3).

Neuroimaging was performed in 45 patients (60%) – MRI in 43 and CT in 2 patients. The most frequent abnormality was cerebral oedema, present in 21 patients (46.7%). Findings suggestive of tubercular meningitis, including basal exudates and hydrocephalus, were noted in 6 patients. Temporal lobe involvement indicative of viral encephalitis was observed in 4 patients. Diffuse demyelination, consistent with ADEM, was seen in 3 patients. Meningeal enhancement was reported in 7 cases, and cerebral infarcts in 2 patients (Table 4).

In terms of management, all 75 patients received empirical intravenous antibiotics. Acyclovir was administered to 56 patients (74.7%) based on suspected viral aetiology, and 68 patients (90.7%) received anti-epileptics for seizure control. Steroids were used for 15 patients (20%), antimalarial drugs for 8 (10.7%), and ionotropes were required for 26 patients (34.7%) due to haemodynamic instability. A total of 56 patients (74.7%) required admission to the paediatric intensive care unit (PICU) and 25 patients (33.3%) required mechanical ventilation due to respiratory failure or decreased consciousness (Table 5).

Table 1.Demographic and clinical profile of acute encephalitis syndrome cases

Variable	Frequency (n)	Percentage (%)
Age (years)		
< 5	50	66.7
5–10	18	24.0
11–14	7	9.3
Gender		
Male	40	53.3
Female	35	46.7
Clinical profile		
Fever	75	100.0
Altered sensorium	75	100.0
Seizures	68	90.7
Vomiting	28	37.3
Headache	6	8.0
Focal neurological deficit	10	13.3
Irrelevant talk	2	2.7
Involuntary movements	5	6.7
Rash	13	17.3
Generalised swelling	5	6.7
Coagulopathy	6	8.0
Respiratory signs	15	20.0
Others	16	21.3

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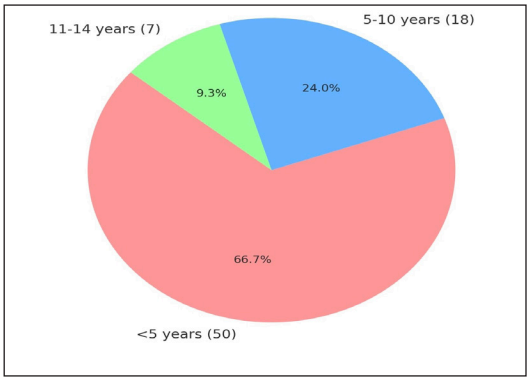

Figure 1.Age-wise distribution of acute encephalitis syndrome cases in children

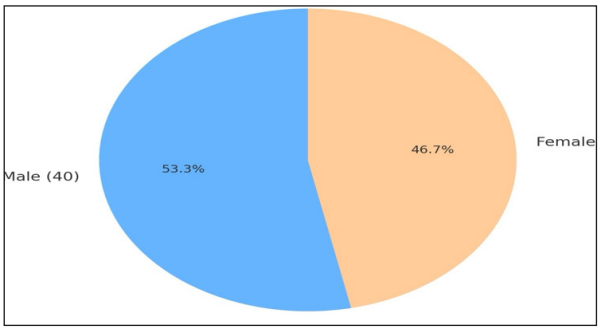

Figure 2.Gender-wise distribution of acute encephalitis syndrome cases in children

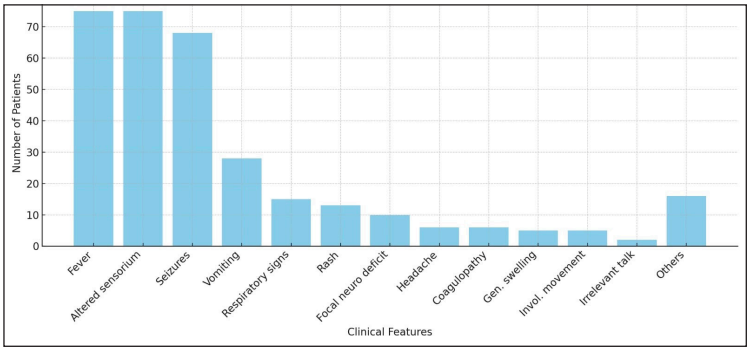

Figure 3.Clinical profile of acute encephalitis syndrome cases in children

Table 2.Etiological distribution of acute encephalitis syndrome cases

Etiological Agent	Number of Cases (n)	Percentage (%)
Scrub typhus meningoencephalitis	15	20.0
Pyogenic bacterial meningitis	12	16.0
Meningoencephalitis of mixed aetiology	7	9.3
Viral encephalitis	7	9.3
Tubercular meningitis	6	8.0
Acute disseminated encephalomyelitis	3	4.0
Enteric encephalopathy	3	4.0
Leptospirosis	2	2.7
Dengue encephalitis	2	2.7
Cerebral malaria	1	1.3
Hepatic encephalopathy	1	1.3
Unknown/ undiagnosed	16	21.3

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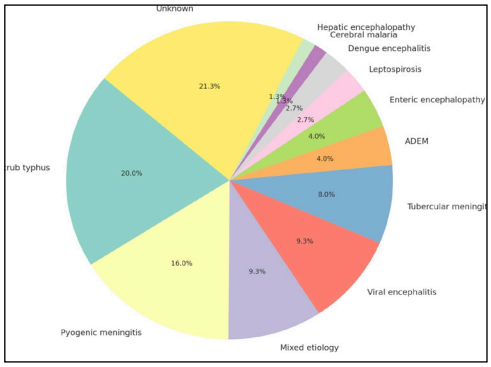

Figure 4.Etiological distribution of acute encephalitis syndrome cases in children

Table 3.CSF Findings in children with acute encephalitis syndrome

Findings	Number of Patients (n)	Percentage (%)
CSF examination	68	90.6
Pleocytosis	53	77.9
Lymphocytic predominance	42	61.8
Neutrophilic predominance	11	16.2
Elevated CSF protein	48	70.6
Low CSF glucose	36	52.9

Table 4.Neuroimaging findings in children with acute encephalitis syndrome

Investigations/ Findings	Number of Patients (n)	Percentage (%)
Neuroimaging	45	60.0
MRI	43	95.6
CT	2	4.5
Cerebral oedema	21	46.7
Basal exudates	6	13.3
Temporal lobe	4	8.9
ADEM-like	3	6.7
Meningeal enhancement	7	15.6
Cerebral infarcts	2	4.5

Table 5.Treatment and Intervention among acute encephalitis syndrome cases

Intervention/ Treatment	Number of Patients (n)	Percentage (%)
PICU admission	56	74.7
Mechanical ventilation	25	33.3
Antibiotics	75	100.0
Acyclovir	56	74.7
Anti-epileptics	68	90.7
Steroids	15	20.0
Antimalarials	8	10.7
Ionotropes	26	34.7

Table 6.Outcome of acute encephalitis syndrome cases

Outcome at Discharge	Number of Patients (n)	Percentage (%)
Full recovery	25	33.3
Minor neurological deficit	26	34.7

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Major neurological deficit	4	5.3
Vegetative state	2	2.7
Death	16	21.3
Refer	2	2.7

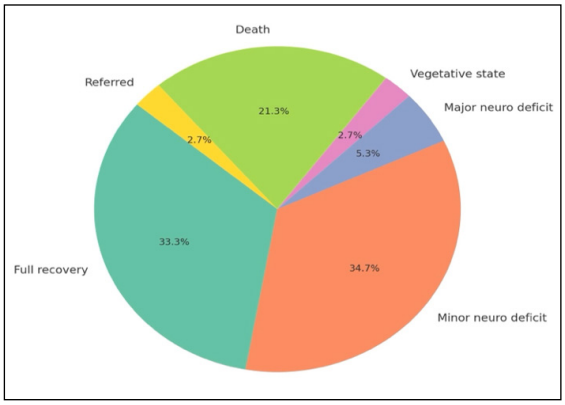

Figure 5.Distribution of outcomes among acute encephalitis syndrome cases

Regarding outcomes, 25 patients (33.3%) had complete recovery without neurological sequelae. Minor neurological deficits, such as behavioural changes, mild cognitive delay, and transient motor weakness, were noted in 26 patients (34.7%), while 4 patients (5.3%) developed major deficits, including persistent hemiparesis. Two patients (2.7%) were in a vegetative state at discharge. There were 16 deaths (21.3%), and two patients (2.7%) were referred to a higher centre before completing treatment (Table 6 and Figure 5).

Discussion

This study provides insight into the clinical profile, etiological spectrum, and outcomes of paediatric AES cases admitted to a tertiary care centre in the rural and underdeveloped region of Mewat, Haryana. The findings highlight important epidemiological patterns and healthcare challenges that are both consistent with and distinct from those in other regions in India.

Mewat, officially known as Nuh district, is one of the most socioeconomically disadvantaged areas in India. The region is characterised by a predominantly rural population, low literacy rates, poor sanitation, limited healthcare access, and a high burden of infectious diseases. These factors significantly influence the clinical presentation, healthcare-seeking behaviour, and outcomes in paediatric AES cases.

The majority of affected children were under 5 years of age (66.7%), due to immature immune systems and environmental exposures, which aligns with studies conducted in Bihar and Eastern Uttar Pradesh, where younger children were disproportionately affected by AES.6,7 Male preponderance observed in our study is consistent with previous reports, possibly reflecting their health-seeking behaviour or inherent biological vulnerability.8

Fever and altered sensorium were universal features in our study, followed by seizures (90.7%), vomiting (37.3%), and respiratory signs (20%). These findings are consistent with clinical presentations noted by Karmarkar et al. and Chatterjee et al., who reported similar symptom distributions in AES cases.9,10

Etiologically, scrub typhus emerged as the most common identifiable cause (20%) in our cohort. This finding is comparable to studies from North India and Northeast states, where scrub typhus has increasingly been recognised as a major contributor to AES.11,12 Pyogenic bacterial meningitis (16%) and viral encephalitis (9.3%) were also significant, reflecting the mixed etiological profile of AES in endemic areas. Notably, 21.3% of cases remained undiagnosed, highlighting diagnostic challenges in resource-limited rural settings like Mewat, which is comparable to findings in studies from Gorakhpur and Assam, where up to 30% of AES cases lacked definitive aetiology due to limited access to advanced diagnostic facilities.13

CSF analysis remains a cornerstone in the diagnostic evaluation of AES. In our study, pleocytosis was observed in 77.9% of patients, with lymphocytic predominance being more common. These findings are consistent with other Indian studies, such as Bhatt et al., where pleocytosis was reported in 70–80% of AES cases, often indicating viral or tubercular aetiology.14 Elevated protein and reduced glucose levels were observed in 70.6% and 52.9% of

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our cases, respectively, similar to findings by Murthy et al., where protein elevation was reported in 65% and hypoglycorrhachia in 45% of children with AES.15

Neuroimaging was performed in 60% of our patients, with MRI being the predominant modality. Cerebral oedema was the most frequent finding (46.7%), which aligns with observations in studies by Mittal et al. and Mahajan et al., where diffuse cerebral oedema was a non-specific but common finding across aetiologies.16,17 Specific imaging features, such as basal exudates and hydrocephalus, seen in 6 patients in our cohort, were characteristic of tubercular meningitis, as also noted by Sharma et al. in a paediatric tubercular meningitis series.18 Temporal lobe involvement was seen in 4 cases and demyelinating changes suggestive of ADEM were seen in 3 patients. This was in line with similar observations in AES cohorts, where post-infectious demyelination was seen to contribute to morbidity.

Thus, CSF and neuroimaging findings not only support clinical suspicion but also help differentiate among aetiologies, especially in resource-limited settings. Incorporating these modalities improves diagnostic yield and contributes to the timely initiation of targeted therapy. In terms of management, 74.7% of children required ICU care, and one-third required mechanical ventilation, indicating the severity of the illness. The high need for intensive care emphasises the severity of AES and the critical need for better-equipped paediatric ICUs in underserved areas. Similar ICU admission rates have been reported in AES surveillance studies from Odisha and UP.19,20 The use of empirical antibiotics, antivirals, and anti-epileptics was widespread, reflecting standard management practices in suspected AES.

Neurological sequelae were observed in a substantial proportion (minor deficits in 34.7%, major deficits or vegetative state in 8%), reinforcing the high burden of long-term morbidity. These outcomes are similar to reports by Joshi et al. and Dwibedi et al., who reported post-encephalitic sequelae in 30–40% of AES survivors.21,22

The mortality rate in our cohort was 21.3%, which is comparable to findings from other resource-limited regions. Studies from Eastern India and Nepal have reported AES-related mortality between 15 and 30%, depending on aetiology and timing of intervention.23,24

This study underscores the need for improved diagnostic capacity, especially in rural settings, to identify treatable causes, such as scrub typhus, early. The unique geographical and socioeconomic profile of Mewat amplifies the public health significance of AES in such areas.

Strengthening critical care services, timely referral, and community awareness are key strategies for reducing AES-associated morbidity and mortality.

Strengths

This study provides region-specific data on the clinical spectrum,etiology, and outcomes of paediatric AES from a rural tertiary care setting in northern India, where such data are scarce. It highlights scrub typhus as a leading cause, emphasising the importance of early diagnosis and appropriate empirical therapy. The study also offers valuable insight into neurological outcomes and critical care needs, contributing to the existing literature on AES in resource-limited settings.

Limitations

Our study had certain limitations; the retrospective nature of the study and reliance on hospital records may have led to incomplete data capture, and a short study period and single-centre design may have limited the external validity of the findings. Etiological diagnosis could not be established in all cases due to constraints related to availability and access to advanced diagnostic tests.

Key Points

Scrub typhus was the most common identifiable cause of paediatric AES in this rural North Indian cohort.

- Fever, altered sensorium, and seizures were the predominant presenting symptoms.
- A significant proportion of patients required intensive care and mechanical ventilation.
- Neurological sequelae were observed in over one-third of the survivors.
- Strengthening regional diagnostic facilities and early empirical therapy can improve outcomes in AES.

Conclusion

In conclusion, AES in children presents with varied clinical features and significant morbidity and mortality. Scrub typhus emerged as the most common identifiable aetiology in this study, underscoring the need for high clinical suspicion and early empirical treatment in endemic areas. The high proportion of patients requiring intensive care and the notable rate of neurological sequelae highlight the need for timely diagnosis, improved critical care infrastructure, and robust follow-up strategies in resource-limited settings. Regional surveillance and diagnostic capacity must be strengthened to reduce the burden of AES.

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Contributors

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BK, AD, SPG: conceptualised the study, collected and interpreted the data and prepared the initial manuscript; AD: supervised the study, reviewed literature and revised the initial manuscript. All authors approved the final version of the manuscript and are accountable for all aspects related to the study.

Data Availability Statement

The data that support the findings of this retrospective study are available from the corresponding author upon reasonable request.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process:None

Source of Funding: None

Competing Interests: None

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