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Original Research Article

A study on etiological profile of children admitted with acute encephalitis syndrome

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ABSTRACT

Background: Acute encephalitis syndrome (AES) is a neurological emergency with significant morbidity and mortality in children. AES is characterized by acute fever, altered mental status, and seizures. Japanese encephalitis (JE) is the leading cause of AES in India, with other viral, bacterial, and parasitic infections also contributing. The study aims to analyse the etiological profile, clinical presentation, and immediate outcomes in children with AES.
Methods: This descriptive study was conducted in the department of pediatrics, Navodaya medical college, Raichur, Karnataka. A total of 56 children aged 1 month to 12 years with AES were included. The clinical presentation, laboratory findings, imaging, and etiological confirmation were analysed.
Results: Among 56 cases, the most affected age group was infants below one year (41.1%), with a male-to-female ratio of 1.4:1. Fever (100%), altered sensorium (85.7%), and seizures (76.8%) were the most common presenting symptoms. Meningeal symptoms were seen in 32.1% of cases. Raised intracranial pressure was observed in 41.1% of cases. Mechanical ventilation was required in 32.1% of cases. Etiology was confirmed in 23.2% of cases, with bacterial infections (8.9%), tuberculosis (5.4%), and viral infections (8.9%), including varicella encephalitis (3 cases) and probable JE (2 cases). The mortality rate was 13%, while 18% had neurological sequelae. Poor Glasgow coma scale (GCS) score, need for mechanical ventilation, and hyponatremia were associated with poor outcomes.
Conclusions: AES remains a major public health concern, with a significant proportion of cases having an unidentified etiology. Early diagnosis, supportive care, and identification of treatable causes can improve outcomes.

Keywords: Acute encephalitis syndrome, Neurological sequelae, Altered sensorium, Mechanical ventilation, Hyponatremia

INTRODUCTION

Central nervous system (CNS) infections are among the most common neurological emergencies in children, contributing significantly to morbidity and mortality. Early identification and management are critical, as subtle manifestations, particularly in infants, necessitate a high index of suspicion for timely diagnosis. A delay or inadequate treatment may result in severe neurological sequelae or even death.[1]

AES

AES is a clinical condition characterized by acute fever, altered mental status, and/or new-onset seizures.[2] This syndrome is caused by a variety of infectious agents, with viral infections being the most common, followed by bacterial, fungal, and parasitic infections.[3] AES can present in both epidemic and sporadic forms, with outbreaks occurring in specific geographic regions.

In India, AES cases are reported predominantly from states such as Assam, Bihar, Karnataka, Tamil Nadu, and Uttar Pradesh, accounting for approximately 80% of reported cases and associated fatalities.[4] The case fatality rate of AES ranges between 20-25%, making it a significant public health concern.[5]

JE and seasonal trends

Among the various etiologies of AES, JE is the most significant in India. The outbreaks of JE typically coincide with the monsoon and post-monsoon periods, which correspond to increased mosquito densities. Other viral etiologies, such as enteroviruses, exhibit year-round incidence due to their waterborne transmission.[6]

The morbidity and mortality associated with AES, especially JE and enteroviral encephalitis, remain high in different regions of India. Patients often suffer from long-term neurological sequelae, including cognitive impairments, motor deficits, and behavioural abnormalities.[7]

Other infectious causes of AES

Apart from JE, other infectious agents contribute to AES cases. Malaria, an endemic disease in India, frequently presents with cerebral malaria, causing severe neurological symptoms.[8] Dengue encephalitis has also been documented, with neurological manifestations such as seizures, encephalopathy, and behavioural disturbances.[9]

Despite the severity of AES, sufficient epidemiological data on treatable causes such as bacterial infections, tuberculosis, and vector-borne viral infections are lacking in India.[10] Several viruses have been implicated in AES outbreaks, including Chandipura virus, West Nile virus, Nipah virus, Kyasanur forest disease virus, enteroviruses, and adenoviruses.[11] Identifying these non-JE AES etiologies is essential for developing targeted public health interventions and policies.[12]

The objectives of this study are to analyze the etiological profile, clinical presentation, and immediate outcomes of AES in children, identify risk factors associated with poor prognosis, assess the need for mechanical ventilation, and highlight the importance of early diagnosis, supportive management, and identification of treatable causes to improve outcomes

METHODS

Selection criteria

This study was conducted on children admitted with AES in the department of pediatrics at Navodaya medical college hospital, Raichur, Karnataka. The study aimed to determine the etiological profile, clinical presentation, and immediate outcomes in children diagnosed with AES.

Type of study

A descriptive study was conducted to analyse the clinical and etiological characteristics of AES in children.

Study duration

The study was carried out in the department of pediatrics, Navodaya medical college hospital, Raichur, Karnataka for duration from January 2023 to February 2024.

Sampling method

A total of 56 children were consecutively recruited based on the provisional diagnosis of AES during the study period.

Inclusion criteria

Children aged 1 month to 12 years admitted with a provisional diagnosis of AES were included in the study. AES was defined based on guidelines from the directorate of national vector borne diseases control programme and WHO, requiring: Acute onset of fever along with at least one of the following*:* Change in mental status (confusion, disorientation, coma, or inability to talk) and new-onset seizures (excluding simple febrile seizures)

Exclusion criteria

The following conditions were excluded from the study: Simple febrile seizures, known seizure disorders, traumatic encephalopathy and metabolic encephalopathy.

Procedure

Clinical assessment: Detailed history, general physical examination, and neurological evaluation were conducted for all patients.

Laboratory investigations: Complete blood count, blood glucose levels, serum electrolytes, cerebrospinal fluid (CSF) analysis, and bacterial cultures were performed.

Serological and radiological tests: JE and varicella encephalitis were diagnosed using IgM ELISA. Tuberculous meningitis was confirmed using GeneXpert (CB-NAAT).

MRI brain was performed for suspected viral encephalitis cases.

Management: Supportive treatment, antiviral therapy, antibiotics, anticonvulsants, and ventilatory support were provided as per clinical requirements.

Outcome assessment: Patients were monitored for complications, need for mechanical ventilation, and neurological sequelae.

Statistical analysis

Data were entered into Microsoft excel and analysed using SPSS software. Descriptive statistics were used to summarize demographic, clinical, and laboratory findings. To assess associations between variables, Chi-square tests and Fisher's exact test were applied. A p value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows age-wise distribution of AES cases. The highest prevalence was observed in infants up to one year (41.1%), followed by children above five years (39.3%) and those aged 1 to 5 years (19.6%).

Table 1: Age distribution.

Age (in years)	N	Percent (%)
Up to 1	23	41.1
1 to 5	11	19.6
>5	22	39.3
Total	56	100

Gender distribution of AES cases. Males (58.9%) were more affected than females (41.1%) in the study.

Table 2: Gender distribution.

Gender	N	Percent (%)
Male	33	58.9
Female	23	41.1
Total	56	100

The commonest presenting symptom was fever (100%). The next common symptom was altered sensorium (85.7%) followed by seizures (76.8%).

Table 3: Symptomatology.

Symptoms	Fever (%)	Altered sensorium (%)	Seizures (%)
Yes	56 (100)	48 (85.7)	43 (76.8)
No	-	8 (14.3)	13 (23.2)

Meningeal symptoms

Among the individuals surveyed, 19.6% reported experiencing headaches, while the majority, 80.4%, did not. Neck pain was less common, with only 7.1% of respondents reporting it, whereas 92.9% did not experience this symptom. Vomiting, however, was the most frequently reported symptom, with 58.9% of individuals experiencing it, while 41.1% did not.

In this study total of 18 patients presented with features of meningeal irritation of which vomiting was the most common complaint (58.9%) followed by headache (19.6%) and neck pain (7.1%).

Other symptoms

Among the respondents, 12.5% reported experiencing loose stools, while hand tremors or hypertonia, Malena, ear pain, and shock were each reported by 1.8% of individuals. The majority, 83.9%, did not report any additional symptoms.

Recurrent seizures

Recurrent seizures were reported in 17 cases, accounting for 30.4% of the total, while 39 cases, representing 69.6%, did not experience recurrent seizures.

Table 4: Signs.

Feature	Yes, N (%)	No, N (%)
Raised ICT	23 (41.1)	33 (58.9)
Focal deficit	3 (5.4)	53 (94.6)
Cranial nerve palsies	2 (3.6)	54 (96.4)
Meningeal signs	18 (32.1)	38 (67.9)

Out of 56 cases 23 children (41.1%) had features of raised ICT which was the most common sign. Meningeal signs were present in 18 (32.1%) children. Focal neurological deficit was present in 3 (5.4%) children and cranial nerve palsies in 2 (3.6%) children.

Table 5: Mechanical ventilation.

Mechanical ventilation	N	Percent (%)
Yes	18	32.1
No	38	67.9

Out of 56 cases 18 cases required mechanical ventilation for various reasons.

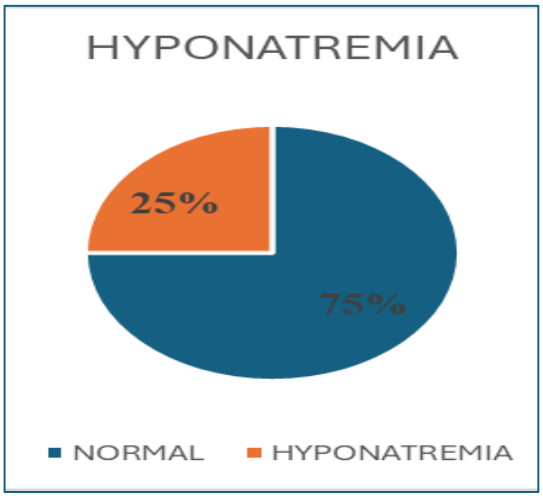

Figure 1: Hyponatremia.

The pie chart represents the distribution of sodium levels among AES cases. A majority (75%) had normal sodium levels, while 25% of cases exhibited hyponatremia.

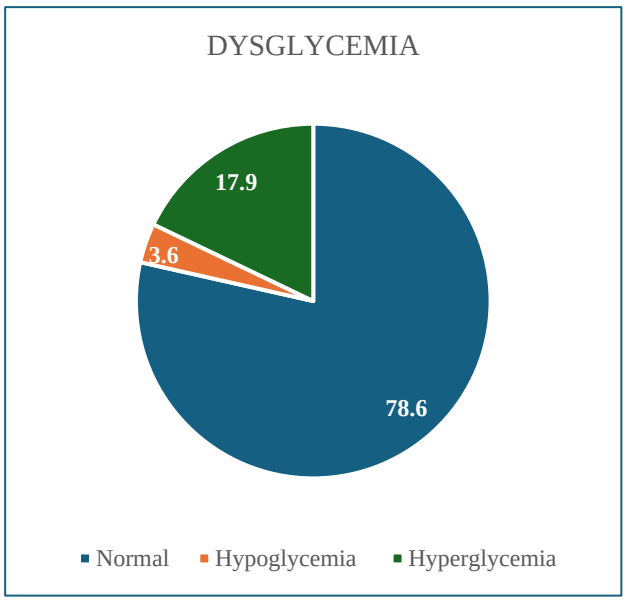

Figure 2: Dysglycemia.

In our study 2 children (3.6%) had hypoglycemia and 10 children (17.9%) had hyperglycemia at the time of admission.

The highest prevalence of AES was observed in infants up to one year (41.1%), followed by children above five years (39.3%) and those aged 1 to 5 years (19.6%).

Table 6: Distribution of outcome.

Outcome	N	Percent (%)
Normal	34	61
Sequelae	10	18
Expired	7	13
Lost follow up	5	9

Out of the total patients, 34 (61%) had a normal outcome, while 10 (18%) experienced sequelae. Unfortunately, 7 patients (13%) expired. Additionally, 5 patients (9%) were lost to follow-up.

DISCUSSION

The age and gender distribution, symptomatology, and clinical patterns observed in this study were consistent with previous research on AES. AES is predominantly caused by viral infections, with common causative agents in Southeast Asia including West Nile virus, Herpes simplex virus, and flaviviruses such as JE and dengue. Long-term neurological sequelae in affected patients often include behavioural problems, cognitive impairment affecting school performance and daily tasks, speech and hearing difficulties, and motor dysfunctions.[12]

The clinical profile of AES patients in this study included vomiting in 33%, seizures in 76.8%, GCS impairment, signs of meningeal irritation in 32.1%, and neurological deficits in 5.4%. A study conducted by Ravi et al. reported similar findings, with vomiting in 41.4%, seizures in 79.3%, altered sensorium in 51.7%, signs of meningeal irritation in 17.2%, and neurological deficits in 34.5% among hospitalized patients suspected of having JE, showing comparable results with the present study.[2] Poor outcomes in AES cases were associated with the need for mechanical ventilation, lower GCS scores, and concurrent seizures.

Among the 11 seropositive cases in this study, 7 (63.6%) were male and 4 (36.3%) were female, a trend also reported in previous studies. This male predominance may be attributed to increased outdoor exposure, particularly in agricultural settings where vector mosquitoes are abundant. The most commonly affected age group was 5 to 12 years (81.8%), likely due to increased mobility, outdoor play, school attendance, and exposure to mosquito-infested rice fields.[3] The highest mortality was associated with JE virus infection, while Herpes simplex virus infection resulted in the most significant residual neuropsychiatric disabilities.[4]

Dysglycemia in AES

Dysglycemia was observed in 21.4% of children in our study. Among them, most patients exhibited blood glucose levels above 140 mg/dl, which may be considered stress-related hyperglycemia. A similar study by Sambasvam et al reported a higher prevalence of dysglycemia at 39.9%.[9]

Hyponatremia in AES

Hyponatremia was present in 25% of cases in our study, a result comparable to the findings of Sambasvam et al who reported a prevalence of 33.3%.[10] In our study, hyponatremia was associated with a poorer prognosis and adverse outcomes.

Final etiology

Among the 56 cases studied, bacterial etiology was confirmed in 5 cases through cerebrospinal fluid (CSF) culture and sensitivity, while 3 cases were identified as tuberculous meningitis (TBM) using GeneXpert. Viral etiology was confirmed in 5 cases, including 3 cases of varicella-zoster virus (VZV) detected through IgM ELISA. One case showed an equivocal result for JE IgM ELISA, while another case had MRI findings suggestive of JE. These two cases were classified as probable JE. Additionally, among the 56 cases, 11 children (19.6%) had a history of developmental delay, whereas 45 children (80%) were developmentally normal.

Our findings highlight the significant burden of AES, emphasizing the need for early diagnosis, appropriate

supportive care, and targeted interventions for preventable and treatable etiologies. Further studies with larger sample sizes and molecular diagnostic tools are essential to improve the understanding of AES and its management in endemic regions.[1,11]

Limitations

The study had certain limitations. The sample size was small, and data were collected from a single hospital in the city, limiting the generalizability of the findings to the broader population. Follow-up was conducted only for a period of four weeks, preventing the assessment of long-term outcomes. Additionally, financial constraints and the unavailability of confirmatory tests like PCR made it difficult to confirm the viral etiology in most cases. Other potential causes, such as malaria and scrub typhus, were not studied, which may have affected the overall etiological analysis

CONCLUSION

AES remains a significant public health challenge due to its diverse etiologies and high morbidity and mortality rates. In our study, AES had a prevalence of 1.03%, with younger children and males being more commonly affected. Fever with altered sensorium was the predominant symptom, and poor outcomes were associated with low GCS scores, need for mechanical ventilation, hyponatremia, and abnormal neuroimaging findings. Despite extensive diagnostic efforts, the etiology remained unidentified in 68% of cases, underscoring the limitations of current diagnostic modalities. Given the burden of AES and its severe consequences, further research and improved diagnostic strategies are essential to enhance early detection, treatment, and prevention.

Recommendations

To reduce the burden of AES, comprehensive surveillance systems should be strengthened to improve case detection and timely diagnosis. Expanding the availability of molecular diagnostic tools and point-of-care testing can help identify specific etiologies more effectively. Preventive strategies, including vaccination programs for JE and other viral pathogens, should be reinforced in endemic regions. Public health interventions such as mosquito control, sanitation improvement, and awareness campaigns on early recognition and management of AES should be prioritized. Multidisciplinary collaboration among healthcare providers, epidemiologists, and policymakers is crucial to developing targeted strategies for reducing AES-related morbidity and mortality.

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