International Journal of Contemporary Pediatrics
*Singh K et al. Int J Contemp Pediatr. 2024 Jun;11(6):669-674*
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20241346

**Original Research Article**

# Role of inflammatory markers in predicting mortality and outcome of acute encephalitis syndrome in children of Eastern Uttar Pradesh India

**Kamaldeep Singh, Bhoopendra Sharma, Vijay Kumar Singh*, Priyanka Singh**

Department of Paediatrics, BRD Medical College, Gorakhpur, Uttar Pradesh, India

**Received:** 11 April 2024
**Revised:** 10 May 2024
**Accepted:** 14 May 2024

***Correspondence:**
Dr. Vijay Kumar Singh,
E-mail: vijaysingh.pedbrd@gmail.com



## ABSTRACT

**Background:** The present study was performed to study the role of inflammatory markers viz. C-reactive protein, procalcitonin, serum ferritin and serum lactate dehydrogenase in predicting the mortality and outcome in patients with acute encephalitis syndrome admitted to pediatrics ICU, BRD medical college, Gorakhpur.
**Methods:** 140 patients/children of the age group ranging from 1 year to 16 years admitted in the acute encephalitis syndrome unit of BRDMC during 1 August 2021 to 31 July 2022 were analyzed with the prospective observational study.
**Results:** Vaccination status ($p<0.001$) and socioeconomic status ($p=0.020$) were associated with mortality outcome in AES patients. Serum procalcitonin levels with cut off value >0.10 mg/dl and serum LDH levels with cut off value of 480 µ/l have shown a positive association with the mortality in AES patients. ($p=0.041$ and $p=0.038$, and strength of association is 0.67 and 0.65, respectively. C-reactive protein with a cut-off value 10 mg/dl and serum ferritin with a cut-off value 140 ng/ml have shown no association with mortality with p values of 0.143 and 0.267, respectively. The Area under the ROC curve is maximum for serum procalcitonin (0.937) with a cut-off value 0.10 ng/dl with 100% sensitivity and 75.8% specificity (confidence interval 95%: 0.894-0.980). The negative predictive value is 100% and PPV is 13.7%. Similarly, the area under the ROC curve for CRP with a cut-off 10 mg/dl is 0.900 (confidence interval 95%: 0.841-0.959) with 100% sensitivity of and 64.8%. specificity. Consequently, the negative predictive value is 100 % and the positive predictive value of 11.1%.
**Conclusions:** For predicting the mortality in AES patients 2 prognostic markers viz. C reactive protein and procalcitonin can prove to be promising prognostic screening tests, and therefore, both the tests are advised consecutively.

**Keywords:** Acute encephalitis syndrome, Prolactin, CRP, Ferritin, Lactate dehydrogenase, Mortality, Sequelae

## INTRODUCTION

Acute Encephalitis Syndrome (AES) is defined as the acute onset of fever following acute change in the mental status (including confusion, disorientation, coma or inability to talk) and/or a new onset of seizures (excluding simple febrile seizures) in a person of any age.[1] The etiology in a large number of AES cases remains unidentified.[2,3] In North America, enteroviruses were found to be the most common etiology in children and HSV-1 in adults.[4,5] In Southeast Asia, Japanese encephalitis is the most common cause in children, accounting for 31%- 45% of cases.[5] Emerging viruses such as Nipah virus, avian influenza H5N1 and bat lyssavirus have recently been linked with encephalitis in humans. Discovery of known pathogens in new regions, such as West Nile virus in Romania, and greater recognition of antibody-mediated encephalitis, where

antibodies develop against neuronal components, such as voltage-gated potassium channels (VGKC) or N-methyl-D- aspartate receptors (NMDAR) are of increasing global concern.[6] Herpes simplex virus, Influenza A virus, West Nile virus, Chandipura virus, mumps, measles, dengue, Parvovirus B4, enteroviruses, Epstein-Barr virus, and scrub typhus, *S. pneumoniae* are the other causes of AES in sporadic and outbreak form in India. Nipah virus and Zika virus are also found as causative agents for AES. However, the etiology in a large number of AES cases remains unidentified.[2,3] Scrub typhus (ST) accounted for about two-thirds of AES cases is also an important etiology of acute febrile illness (AFI) in the region.[7-12] Untreated cases of ST-attributable AFI can progress to AES. The mortality rate of AES in UP ranges between 8 to 35% and those affected are typically children aged <15 years and the young adults.[13,14] The present study was performed to study the role of inflammatory markers viz. C-reactive protein (CRP), procalcitonin, serum ferritin and serum lactate dehydrogenase in predicting the mortality and outcome in patients with acute encephalitis syndrome admitted to pediatrics ICU, BRD medical college, Gorakhpur.

## METHODS

### *Type of study*

The present study was prospective observational study, and aimed to understand the role of inflammatory markers such as CRP, procalcitonin, serum ferritin and serum lactate dehydrogenase in predicting the mortality and outcome in patients with acute encephalitis syndrome admitted in pediatrics ICU of BRDMC, Gorakhpur.

### *Statistical tools*

Fisher exact test was followed to establish the relationship between vaccination status and the outcome, to establish an association between CRP and outcome, an association between raised procalcitonin level and outcome, to establish an association between raised serum LDH and outcome and to establish an association between raised serum Ferritin and outcome in AES patients and data analyzed by SPSS-22 software.

### *Sample size*

Sample size was calculated by using formula:

$$n = Z2P(1 - P)/e2$$

Were Z=z score, P=prevalence of disease (9.8%), and e-margin of error (5%).[2] Thus, total sample would be (n=140).

A total of n=150 AES patients were enrolled during study 7 of them refused to participate in this study, and 3 of them left against medical advice after admission in the paediatrics department of BRD Medical College, Gorakhpur during 1 August 2021 to 31 July 2022 hence n=140 patients were included for study and analyses.

### *Laboratory investigations*

Procalcitonin was measured by SFBC method using Abbott architect machine having normal range 5.18 to 26.53 ng/ml; C Reactive Protein was measured by Particle enhanced turbidimetric assay method with Selectra Pro machine having normal range 0 to 6 mg/l; serum lactate dehydrogenase was measured by SFBC, Kinetic UV (substrate=pirovate) method using selectra pro machine having normal range 240 to 480 µ/l and serum ferritin was measured by CMIA (chemiluminescent microparticle immunoassay) method with Abbott architect analyser having normal range: 6-15 yr =7-140 ng/ml male=22-322 ng/ml female=10-291 ng/ml.

### *Inclusion criteria*

Written informed consent was made available from the parents/guardians of the Children above the age of 1 year and that of less than 16 years coming with the acute onset of fever of ≤7 days and with a change in mental status (including symptoms such as confusion, disorientation, coma, or inability to talk and/or new onset of seizures.

### *Exclusion criteria*

Single generalized convulsion lasting <15 minutes and who recovers consciousness within 60 minutes of the seizure, patients with no altered sensorium, patients with febrile seizures, patients with a recent history of trauma to head were taken into account for exclusion. Likewise, CSF is suggestive of bacterial meningitis, based on either a positive culture for pathogenic bacteria, five or more polymorphonuclear cells in CSF, CSF glucose <40 mg/dl, or a CSF/blood glucose ratio <0.25, positive mycobacterial cultures for tubercular meningitis (mycobacterial cultures were done with 1 ml of the freshly collected CSF, which was inoculated in BACTEC), bain imaging, if performed suggested an intracranial lesion compatible with a non-AES etiology, a definite metabolic or known infectious etiology for the illness was detected in the course of the hospital stay and patients with toxic & metabolic encephalopathy were excluded.

## RESULTS

Demographic traits of acute encephalitis syndrome exhibited that the majority of patients enrolled were of the age group of 5 to 10 years (N=57, 41%) followed by an age group of <5 years with a slight predilection for girls (N=76, 53%). 80% (N=112) patients had a history of vaccination. The majority of patients were from lower Middle (N=66,46%) socioeconomic status according to modified Kuppu Swamy scale followed by upper lower class (N=54, 38.6%). 80% (N=111) were not from

Gorakhpur but were from adjoining areas. Usually, patients had an admission duration of more than 10 days (N=99,70.7%). Apart from the history of fever and altered sensorium, which was present in all the patients, the latter presented with seizures (N=124, 88.6%), headache (N=112, 80%), and vomiting (N=114, 81.5%). Edema was present in 6 patients (4.28%). At the time of presentation to pediatric emergency majority of patients (N=112, 80%) had mean GCS of 8-12 i.e., moderate. Only 4 patients had mean GCS of mild category (Table 1).

**Table 1: Demographic and clinical details of AES patients.**

| Parameters | Categories | N | % |
|---|---|---|---|
| **Age (years)** | <5 | 46 | 33 |
| | 5-10 | 57 | 41 |
| | >10 -16 | 37 | 26 |
| **Gender** | Males | 64 | 45.7 |
| | Females | 76 | 54.3 |
| **Socio-economic status** | Upper lower | 54 | 38.6 |
| | Lower middle | 65 | 46.4 |
| | Upper middle | 21 | 15.0 |
| **Vaccination History** | Y | 112 | 80 |
| | N | 28 | 20 |
| **Address** | Gorakhpur | 29 | 20 |
| | Outside Gorakhpur | 111 | 80 |
| **Duration of stay (days)** | ≤10 | 41 | 29.2 |
| | >10 | 99 | 70.7 |
| **Edema** | Yes | 6 | 4.28 |
| | No | 134 | 95.72 |
| **Seizure** | Yes | 124 | 88.6 |
| | No | 16 | 11.4 |
| **Headache** | Yes | 112 | 80 |
| | No | 28 | 20 |
| **Vomiting** | Yes | 114 | 81.5 |
| | No | 26 | 18.5 |
| **GCS** | Mild (13-15) | 4 | 2.9 |
| | Moderate (8-12) | 112 | 80.0 |
| | Severe (≤7) | 24 | 17.1 |
| **Sequelae** | | 9 | 6.4 |
| | | 131 | 93.6 |

Fisher exact test followed to establish the relationship between vaccination status and the outcome showed a significant Association ($\chi^2$=17.86, p<0.001). It implies that patients who were not vaccinated for AES had a higher mortality rate. The strength of association calculated (Cramer V) is 0.98 (strong association). Likewise, Fisher exact test to establish an association between CRP and outcome in AES patients showed a significant association ($\chi$2=3.889, p=0.143 (>0.05)). 77.1% of patients with AES had raised CRP levels >10 mg/dl. However, there was no expiry seen in patients having CRP levels <10 mg/dl (Table 2).

Fisher exact test followed to establish an association between raised procalcitonin level (>0.1 ng/dl) and outcome in AES patients showed significant association; $\chi$2=6.310, p=0.041 (<0.05). The strength of association between Procalcitonin and outcome by Cramer V is 0.67 (strong positive association). There was no death in patients having procalcitonin level ≤0.1 ng/dl. Likewise, Fisher exact test was used to establish an association between raised serum LDH (>480 µ/l) and outcome in AES patients revealed significant association; $\chi$2=4.308, p=0.038 (<0.05). The strength of the association between serum LDH and outcome (Cramer V) is 0.65 (moderate association). There were 9 deaths out of 12 (75%) had serum LDH levels above 480 µ/l (Table 2). Again, Fisher exact test to establish an association between raised serum ferritin (>140 ng/ml) and outcome in AES patients revealed no significant association; $\chi$2=1.230, p=0.267 (>0.05). There was no expiry having serum ferritin levels <140 ng/ml whereas patients expired had serum ferritin levels more than 140 ng/ml (Table 2). Out of N=109 patients, 9 patients (8.25%) had sequelae at the time of discharge, 1 patient (11.1%) had left-sided hemiparesis with no cranial nerve involvement, 3 patient (33.3%) had behaviour abnormality (hyperactivity, impulsive behaviours, and biting) and 5 patients (55.6%) had movement disorder including tremors, myoclonus, and chorea or chorea like movements (Figure 1).

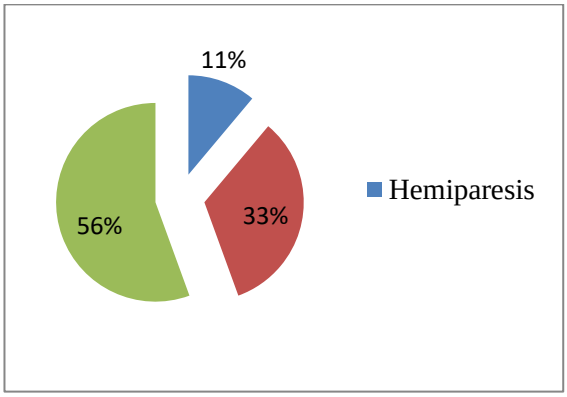


**Figure 1: Type of sequelae in scrub typhus positive AES patients.**

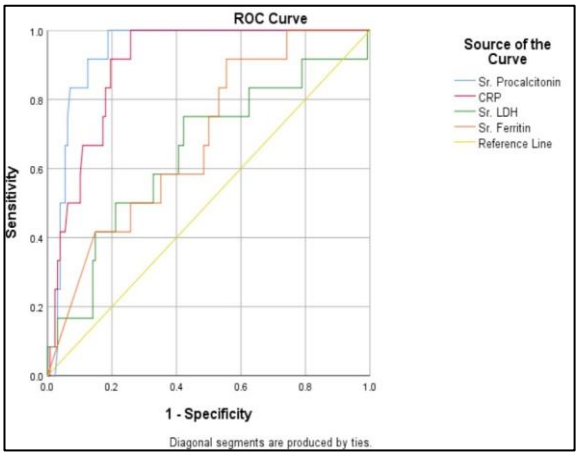


**Figure 2: ROC curve.**

Receiver operating characteristics (ROC) revealed that the closer the area is to 1.0, the better the test is, while the closer the area is to 0.5, the worse the test is. In this analysis, the area of procalcitonin and CRP are 0.937and 0.900, respectively.

**Table 2: Association between selected variables and outcome of AES patients.**

| Variables | Category | Outcome | | Fisher exact test | |
|---|---|---|---|---|---|
| | | Death N (%) | Discharge N (%) | $X^2$ | P value |
| **Vaccination history** | No | 8 (28.6) | 20 (71.4) | 17.86 (1) | <0.001 |
| | Yes | 4 (3.6) | 108 (96.4) | | |
| | Total | 12 | 128 | | |
| **CRP (ng/dl)** | <10 | 0 (0.0) | 32 (100) | 3.889 (1) | 0.193 |
| | >10 | 12 (11.1) | 96 (88.9) | | |
| | Total | 12 | 128 | | |
| **Procalcitonin (ng/dl)** | ≤0.1 | 0 (0.0) | 53 (100) | 6.310 (1) | 0.041 |
| | >0.1 | 12 (13.7) | 75 (86.3) | | |
| | Total | 12 | 128 | | |
| **Serum LDH (µ/l)** | <480 | 3 (4) | 72 (96) | 4.308 (1) | 0.038 |
| | >480 | 9 (13.8) | 56(86.2) | | |
| | Total | 12 | 128 | | |
| **Serum ferritin (ng/ml)** | >140 | 12 (9.4) | 116(90.6) | 1.230 (1) | 0.267 |
| | ≤140 | 0 (0.0) | 12 (100) | | |
| | Total | 12 | 128 | | |

**Table 3: Receiver operating characteristics analysis.**

| Investigation | Area under curve (AUC) | P value | Cut-off value | Sensitivity (%) | Specificity (%) | Asymptomatic 95% CI | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower bound | Upper bound |
| **Procalcitonin** | 0.937 | <0.001 | 0.1 ng/ml | 100 | 75.8 | 0.894 | 0.980 |
| **CRP** | 0.900 | <0.001 | 10 mg/dl | 100 | 64.8 | 0.841 | 0.959 |
| **Serum LDH** | 0.647 | 0.093 | 480 µ/l | 75 | 43.0 | 0.473 | 0.822 |
| **Serum ferritin** | 0.684 | 0.035 | 140 ng/ml | 100 | 90.6 | 0.542 | 0.826 |

Both these results were much larger than 0.5. However, the area of procalcitonin is closer to 1.0 advocates that procalcitonin is better than CRP. It shows that the area under the ROC was maximum for serum procalcitonin (0.937) with a cut-off value of 0.1 ng/dl with a sensitivity of 100% and specificity of 75.8% (95% confidence interval: 0.894-0.980). Similarly, the area under the ROC for CRP is 0.900, and for serum ferritin and Serum LDH is 0.684 and 0.647, respectively. Sensitivity for CRP and serum ferritin is also100% but specificity is 64.8% and 90.6%, respectively. Likewise, the sensitivity for serum LDH is 75% and the specificity is 43% (Table 3).

## DISCUSSION

The present study revealed that the incidence of AES had a slight female preponderance with ratio of 1.12:1, and the most commonly affected group was 5 to 10 years age group as against the report of Kumar et al.[15] With 69.3% of cases occurring in rural areas and 30.7% in urban areas perhaps because of open defecation in rural regions where it makes people more vulnerable to chigger bites. The majority of cases happened in the months of August to December, i.e., during the monsoon and post-monsoon seasons when vegetation growth and mite populations were at their highest. In 0% to 70% of the cases, eschar at the location of the chigger bite was described as a pathognomic characteristic. During present investigation no case of eschar was found which was comparable to earlier studies where eschar was not observed. It has been suggested that differences in cutaneous immunity and dark skin are the causes of an absent eschar, which can potentially go unnoticed if youngsters are not thoroughly evaluated. During 2012-2013 a survey on JE vaccine coverage by Murhekar et al found low overall vaccine coverage (72.3% for single dose and 42.3% for booster/second dose) in Gorakhpur division (4 districts viz., Deoria, Kushinagar, Gorakhpur, Maharajganj).[7] However, over the course of time the vaccination coverage has increased to 80% due to various National programmes and introduction of JE vaccine in the universal immunization program as deduced from this study. Also, the mortality has reduced till 8.57% after increasing the vaccination coverage.

In adults independent connection between oliguric AKI and mortality has been reported as the age in years and serum creatinine >1.4 mg/dl were independent predictors

of mortality in scrub typhus patients.[15] Present study revealed that vaccination status (p<0.001) was negatively associated with sequelae whereas socioeconomic status (p=0.847) was not associated with to the sequelae in AES patients getting discharged. According to Narain et al 30-40% survivors have had residual neurological sequelae leading to poor quality of life whereas in the present study, 6.4% patients developed significant sequelae at the time of discharge quite similar to the study carried out by Gangwar et al where it was found that 10.3% had moderate and 2.7% had severe degree of disability.[16] During this study vaccination status (p<0.001), socioeconomic status (p=0.02) and complications like respiratory failure (p<0.001), shock (p=0.055), DIC (p=0.012), myocarditis (p=0.041) were associated with bad outcome (mortality) in AES patients. Mean GCS at admission (p<0.001) is negatively and strongly associated with mortality.

Serum procalcitonin levels and serum LDH levels has shown a negative association with outcome in AES patients (p=0.041 and p=0.038, respectively). C-reactive protein and serum ferritin has shown no association with the mortality with p value of 0.143 and 0.267, respectively. Kumari et al reported that the mortality rate of AES in UP ranges between 8% to 35%, and those affected are typically the children aged <15 years and young adults.[17] Likewise in this study the mortality was 8.57% (N=12) and mostly in the age group of 5-10 years. Results of the present study showed that procalcitonin has sensitivity of 100% which means that there are few false negative results and thus fewer cases of disease are missed. PPV shows that an individual with a positive test truly has a particular disease in question. It was revealed that PPV for procalcitonin was 13.7% confirming that procalcitonin is the best test for AES in comparison to serum ferritin, serum LDH and CRP.

The specificity of a test is its ability to designate an individual who does not have a disease as negative. Negative predictive value for procalcitonin is 100% and PPV is 13.7% in this study. Similarly, NPV for serum ferritin according to the statistics in this study is 100% and PPV is 9.3%. NPV for serum LDH in the above study is 4% and PPV IS 13.8%. If the CRP and procalcitonin are applied in parallel i.e., simultaneously in an "or" manner i.e., if either test is positive, then the disease or condition is present, the sensitivity becomes 100% and specificity becomes 49.1%. If the CRP and procalcitonin are applied in series in AES patients i.e., subsequently, in an "and" manner i.e., if test A is negative then the second test B does not need to be performed, then sensitivity becomes 100% and specificity becomes 91%. So, for predicting the mortality in AES patients 2 prognostic markers namely, C reactive protein and procalcitonin can prove to be promising prognostic screening tests if both these tests are advised in succession one after the other. Patients having CRP positive (in pathological range) can be ordered for serum procalcitonin levels and if procalcitonin is also positive (lying in pathological range), then the chances of mortality are higher in that particular group of patients in comparison to others.

### *Limitations*

Written consents were taken from the parents/guardians of the Children selected for study coming with the acute onset of fever of ≤7 days and with a change in mental status (including symptoms such as confusion, disorientation, coma, or inability to talk and/or new onset of seizures. However, patients with single generalized convulsion lasting <15 minutes and who recovers consciousness within 60 minutes of the seizure, patients with no altered sensorium, patients with febrile seizures, patients with a recent history of trauma to head were taken into account for exclusion. Likewise, CSF is suggestive of bacterial meningitis, based on either a positive culture for pathogenic bacteria, five or more polymorphonuclear cells in CSF, CSF glucose <40 mg/dl, or a CSF/blood glucose ratio <0.25, positive mycobacterial cultures for tubercular meningitis (mycobacterial cultures were done with 1 ml of the freshly collected CSF, which was inoculated in BACTEC), brain imaging, if performed suggested an intracranial lesion compatible with a non-AES etiology, a definite metabolic or known infectious etiology for the illness was detected in the course of the hospital stay and patients with toxic and metabolic encephalopathy were excluded from the study.

## CONCLUSION

The present study revealed that vaccination status and socioeconomic status were associated with mortality in AES patients. Serum procalcitonin levels with cut off value of >0.1 mg/dl and serum LDH levels with cut off value of 480 µ/l has shown a positive association with mortality in AES patients. C- Reactive protein with a cut off value of 10 mg/dl and serum ferritin with the cut off value of 140 ng/ml has shown no association with the mortality. As such, the serum procalcitonin and Serum LDH can be used to predict the sequelae in AES patients whereas CRP and serum ferritin are not associated with sequelae in the latter. Similarly, the area under the ROC for CRP with cut off value of 10 mg/dl was 0.900, with 100% sensitivity and 64.8% specificity. Hence the negative predictive value was 100% and the positive predictive value was 11.1%. Area under the ROC for serum ferritin and Serum LDH was 0.684 and 0.647, respectively. Sensitivity for serum ferritin was also 100% but specificity was 90.6%. NPV for serum ferritin was 100% and PPV was 9.3%, Sensitivity for serum LDH was 75% and specificity was 43% and NPV for serum LDH was 4% and PPV was 13.8%.

### *Recommendations*

Procalcitonin is a best screening test for AES in comparison to serum ferritin, serum LDH and CRP for

predicting mortality in AES patients. If the CRP and procalcitonin are applied in a series in AES patients i.e., subsequently, in an "and" manner, then sensitivity becomes 100% and specificity becomes 91%.

## ACKNOWLEDGEMENTS

Authors would like to thank to D. K. Chaudhary for managing data during the study.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

## 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. Bull World Health Org. 2008;86(3):178-86.
2. Jain P, Jain A, Kumar A, Prakash S, Khan DN, Singh KP, et al. Epidemiology and etiology of acute encephalitis syndrome in North India. Jpn J Infect Dis. 2014;67:197-203.
3. Gupta S, Shahi RK, Nigam P. Clinico-etiological profile and predictors of outcome in acute encephalitis syndrome in adults. Int J Sci Study. 2016;3:78-83.
4. Glaser CA, Honarmand S, Anderson LJ, Schnurr DP, Forghani B, Cossen CK, et al. Beyond viruses: clinical profiles and etiologies associated with encephalitis. Clin Infect Dis. 2006;43(12):1565-77.
5. Le VT, Phan TQ, Do QH, Nguyen BH, Lam QB, Bach V, et al. Viral etiology of encephalitis in children in southern Vietnam: results of a one-year prospective descriptive study. PLoS Neglect Trop Dis. 2010;4(10):e854.
6. Solomon T, Michael BD, Smith PE, Sanderson F, Davies NW, Hart IJ, et al. Management of suspected viral encephalitis in adults--Association of British Neurologists and British Infection Association National Guidelines. J Infect. 2012;64(4):347-73.
7. Murhekar MV, Mittal M, Prakash JAJ, Pillai VM, Mittal M, Girish Kumar CP, et al. Acute encephalitis syndrome in Gorakhpur, Uttar Pradesh, India-role of scrub typhus. J Infect. 2016;73:623-6.
8. Mittal M, Thangaraj JWV, Rose W, Verghese VP, Kumar CPG, Mittal M, et al. Scrub typhus as a cause of acute encephalitis syndrome, Gorakhpur, Uttar Pradesh, India. Emerg Infect Dis. 2017;23:1414-6.
9. Pulla P. Disease sleuths unmask deadly encephalitis culprit. Science. 2017;357:344.
10. Mittal M, Bondre V, Murhekar M, Deval H, Rose W, Verghese VP, et al. Acute encephalitis syndrome in Gorakhpur, Uttar Pradesh, 2016: clinical and laboratory findings. Pediatr Infect Dis J. 2018;37:1101-6.
11. Vivian Thangaraj JW, Kumar CPG, Rose W, Sabarinathan R. Scrub typhus as an etiology of acute febrile illness in Gorakhpur, Uttar Pradesh, India, 2016. Am J Trop Med Hyg. 2017;97:1313-5.
12. Thangaraj JW, Vasanthapuram R, Machado L, Arunkumar G, Sodha SV, Zaman K, et al. Risk factors for acquiring scrub typhus among children in Deoria and Gorakhpur districts, Uttar Pradesh, India, 2017. Emerg Infect Dis. 2018;24(12):2364.
13. Narain JP, Dhariwal AC, MacIntyre CR. Acute encephalitis in India: an unfolding tragedy. Indian J Med Res. 2017;145:584.
14. Kumari R, Joshi PL. A review of Japanese encephalitis in Uttar Pradesh, India. WHO South East Asia J Public Health. 2012;1:374-95.
15. Kumar R, Tripathi P, Singh S, Bannerji G. Clinical features in children hospitalized during the 2005 epidemic of Japanese encephalitis in Uttar Pradesh, India. Clin Infect Dis. 2006;43:123-31.
16. Gangwar SP, Thangaraj JW, Zaman K, Vairamani V, Mittal M, Murhekar M. Sequelae following acute encephalitis syndrome caused by Orientia tsutsugamushi. Pediatr Infect Dis J. 2020;39(5):e52-4.
17. Kumari R, Joshi PL. A review of Japanese encephalitis in Uttar Pradesh, India. WHO South East Asia J Public Health. 2012;1:374-95.

**Cite this article as:** Singh K, Sharma B, Singh VK, Singh P. Role of inflammatory markers in predicting mortality and outcome of acute encephalitis syndrome in children of Eastern Uttar Pradesh India. Int J Contemp Pediatr 2024;11:669-74.