

## ORIGINAL ARTICLE

# The clinical analysis of new-onset status epilepticus

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## Abstract

**Objective:** To investigate and analyze the etiology and prognosis of patients with new-onset status epilepticus (NOSE).

**Methods:** We conducted a retrospective analysis of all adult patients ( $\geq 16$  years old) who were admitted to Sichuan Provincial People's Hospital between January 2018 and December 2020 with status epilepticus (SE) and no prior epilepsy history.

**Results:** We collected data from 85 patients, aged from 16 to 90 years, of whom 49 were male and 36 were female. Fifty-five of these cases (64.7%) were younger than 60 years of age. Acute symptomatic SE was mostly seen in the NOSE (53.9%), followed by unknown SE (25.9%), progressive SE (11.8%), and remote SE (9.4%). The differences in the etiology of NOSE between age groups were statistically significant ( $P < .05$ ). For the young, the main etiology remained unknown (36.3%), followed by autoimmune-related SE (16.4%); in the elderly, the primary etiology was central nervous system (CNS) infection (23.3%), followed by cerebrovascular disease (20%), and intracranial tumors (20%). Normal imaging was mostly seen in young people with NOSE ( $P < .001$ ). Regarding outcome parameters and risk factors in patients with NOSE, adverse outcome was associated with age (OR = 3.5, 95% CI = 0.108–0.758,  $P = .012$ ), co-infection (OR = 4.5, 95% CI = 0.083–0.599,  $P = .003$ ), and tracheal intubation (OR = 6.318, 95% CI = 0.060–0.204,  $P = .011$ ).

**Significance:** In our cohort, intracranial tumors, CNS infections, and cerebrovascular disease were the predominant causes of NOSE in the elderly, while autoimmune encephalitis was the largest recognized cause of NOSE in young patients. In addition, imaging varies with age. According to the data, preventing infections may enhance patient prognosis because greater infection rates are connected with less favorable results. Meanwhile, age and mechanical ventilation are related to the prognosis of NOSE.

## KEYWORDS

clinical characteristics, etiology, prognosis

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## 1 | INTRODUCTION

Status epilepticus (SE) is a common neurological emergency with high morbidity, mortality, and disability.<sup>1-3</sup> The literature has reported an annual incidence of approximately 10-40/per 100 000 and a mortality rate of 16%-39%, second only to cerebrovascular disease.<sup>4-8</sup> Current studies have found that patients with SE have many comorbidities. SE can be induced by a combination of etiologies belonging to multiple categories, further complicating the exploration of etiology.<sup>9,10</sup> To reduce the interference of multiple factors, experts have introduced a new concept of “new-onset status epilepticus”(NOSE), which is the occurrence of seizures lasting more than 5 minutes or recurrent seizures that do not reach baseline in patients with no previous history of epilepsy.<sup>11</sup>

Numerous studies indicated that more than 40% of NOSE patients will develop chronic epilepsy during the next 10 years and are more likely to develop new-onset refractory status epilepticus (NORSE), applied to a patient without a prior diagnosis of epilepsy or other preexisting relevant neurological disorder, with new onset of refractory SE (RSE) that does not respond to first- and second-line antiseizure drugs and no clear acute or active structural, toxic, or metabolic cause. Meanwhile, making NOSE a serious risk factor for death among SE patients.<sup>12-16</sup> Studying its pathogenesis and clinical characteristics can thus aid in early detection and appropriate treatment, lowering complications, and increasing prognosis.

Contrary to earlier investigations in patients with epilepsy SE, there are currently few studies on the etiology of NOSE globally. In current studies, central system infections and cerebrovascular accidents are the main causes of NOSE, while a few foreign studies on NOSE have found its etiology to be mainly related to alcohol-related.<sup>11,16,17</sup> Furthermore, there is a need to recognize the etiology of the NOSE, which will help guide treatment strategies, perform precision medicine, and predict clinical outcomes. Therefore, this study aimed to collect data from these patients, summarize the clinical characteristics of NOSE, and analyze their etiology and prognosis.

## 2 | MATERIALS AND METHODS

### 2.1 | Patient information

NOSE patients admitted to Sichuan Provincial People's Hospital from January 1, 2018, to December 31, 2020, were retrospectively collected by searching for “status epilepticus” and “epilepsy” in the electronic medical records. We included patients with NOSE strictly according to the following inclusion and exclusion criteria

### Key Points

- The etiological distribution of new-onset status epilepticus (NOSE) differs from that of status epilepticus with epilepsy.
- The etiology of the NOSE varies by age.
- Poor outcomes in NOSE were associated with older age as well as mechanical ventilation therapy and co-infection.

and analyzed their etiologies based on medical history and auxiliary examinations, especially electro-encephalogram, imaging, and cerebrospinal fluid.

### 2.1.1 | Inclusion criteria

All enrolled SE patients met the most recent International League Against Epilepsy (ILAE) 2015 guidelines for SE (including generalized tonic-clonic seizures lasting greater than 5 minutes or having two or more seizures between which there is incomplete recovery of consciousness; or focal seizures with and without impaired consciousness or absence seizures lasting at least 10 minutes)<sup>17</sup>; age  $\geq 16$  years; patients were willing to participate in the study project and signed an informed consent form with substantially complete information.

### 2.1.2 | Exclusion criteria

Pregnant and lactating women; patients with prior history of epilepsy or seizures; patients with incomplete information.

This study was in accordance with the hospital's ethical review.

## 2.2 | Study method

We collected information on patients' basic information (including age, gender, and ethnicity), symptomatology, seizure duration, laboratory testing (including blood glucose, electrolytes, magnesium, calcium, phosphorous, complete blood count, serum transaminases, and toxicology), screen ancillary examinations (including electroencephalogram [EEG], imaging, and cerebrospinal fluid results), treatment, complications, length of hospitalization, whether they were admitted to the ICU, whether they were extubated, and prognosis.

## 2.3 | SE etiology

Determined by the common neurologist, the main cause of SE is consistent with the concepts of the ILAE guidelines as symptomatic acute, remote, progressive or unknown: Acute etiologies include stroke, intoxication, malaria, encephalitis, etc. Remote etiologies included posttraumatic, postencephalitic, poststroke, etc. Progressive etiologies included brain tumor, Lafora's disease, other progressive myoclonic epilepsy (PME), and dementias. Therefore, as we know, SE has plenty of specific causes: cerebrovascular accidents, CNS infections, neurodegenerative diseases, intracranial tumors, cortical dysplasia, head trauma, alcohol-related, intoxication, withdrawal of or low levels of antiepileptic drugs, cerebral hypoxia or anoxia, metabolic disturbances, autoimmune diseases causing SE, mitochondrial diseases causing SE, chromosomal aberrations and genetic anomalies, neurocutaneous syndromes, metabolic diseases, and others.<sup>17</sup> In most cases, the etiology is reliably diagnosed by the patients' clinical history, physical examinations, inspection results, imaging studies, electroencephalograph (EEG), cerebrospinal fluid, and other tests. However, if SE patients have multiple pathogenies, the leading contributory factors were considered in categorizing the cause as the ILAE etiology.<sup>17</sup> In this research, we studied patients with NOSE who can exclude some interfering factors, such as the use of antiepileptic drug withdrawal. In addition, if someone was intoxicated, we could identify the drug by using medical history and detection of toxic residues in his/her blood and urine.

Determined by the general neurologists, the primary etiology of SE is consistent with the concepts of the ILAE guidelines as symptomatic acute, remote, progressive, or unknown: Acute etiologies include stroke, intoxication, malaria, encephalitis, etc. Remote etiologies included posttraumatic, post-encephalitic, post-stroke, etc. Progressive etiologies are composed of brain tumors, Lafora's disease, dementia, and other PME. In addition, there are many specific causes of SE, such as cerebrovascular accidents, central nervous system (CNS) infections, neurodegenerative diseases, intracranial tumors, cortical dysplasia, head trauma, alcohol-related, intoxication, withdrawal of or low levels of antiepileptic drugs, cerebral hypoxia or anoxia, metabolic disturbances, autoimmune diseases causing SE, mitochondrial diseases causing SE, chromosomal aberrations, genetic anomalies, neurocutaneous syndromes, metabolic diseases, and others.<sup>17</sup> In most cases, the etiology can be reliably diagnosed by the patients' clinical history, physical examinations, inspection results, imaging studies, EEG, Cerebrospinal fluid, and other tests. However, if SE patients have multiple pathogenies, the leading contributory factors were considered in categorizing the cause as an ILAE etiology.<sup>17</sup>

In this study, we confirmed that NOSE patients with acute neurological (stroke, head trauma, or CNS infection) or systemic (electrolyte disturbance or hypoxia) causes were classified as acute symptomatic. NOSE patients were classified as remote symptomatic if they had a previous injury such as stroke or head trauma and had no evidence of acute seizure provocation. When progressive neurological deficits (dementia, intracranial tumors) were present, EEG changes consistent with lesions were classified as progressive symptom groups.<sup>18</sup> Despite extensive diagnostics, no cause of SE was identified in patients without a history of epilepsy, and many idiopathic epilepsies were identified as having unknown causes.<sup>17,19</sup> We can determine whether a patient has been intoxicated based on the patient's medical history and the presence of toxic substances in the blood or urine.

A favorable outcome occurred if the modified ranking scale (mRS) at discharge did not deteriorate compared to preclinical status, or if mRS was <2 at discharge. On the contrary, it was an unfavorable outcome.

## 2.4 | Statistical analysis

SPSS 26.0.0.0 software was used for statistical analysis, where we used descriptive statistics to examine the characteristics of the study sample. Then, for continuous variables that followed a normal distribution, we utilized mean  $\pm$  standard deviation; for those that did not, we used the median. For continuous variables that followed a normal distribution, *t*-tests were employed; for measurements that did not follow a normal distribution, non-parametric tests were utilized. For dichotomous and unordered multi-classification data, the chi-square test or Fisher's exact probability technique was used for group comparison, while the Mann-Whitney rank-sum test was employed for ordered multi-classification data. A logistic regression model was used in multivariate analysis to evaluate the outcome factors.

## 3 | RESULTS

We reviewed a total of 165 patients with the diagnosis of SE, eventually, 85 patients conformed to meet the predefined criteria of this study. These patients were aged 16-90 years, with a mean of  $49.41 \pm 21.31$  years, including 49 males with a mean of  $47.78 \pm 19.72$  years, and 36 females with a mean of  $50.52 \pm 24.63$  years. Most of them were Han, and only a few were the minority. The majority of semiology as convulsive SE, most of the episodes lasted less than 1 hour, and the main treatment was antiepileptic drugs. Infection as a complication was seen in 30 patients

TABLE 1 Patient characteristics

Items	Cases	Constituent ratio
Sex (Male/Female)	49/36	57.6% vs 42.4%
Age (<60y/≥60y)	55/30	64.7% vs 35.3%
National		
Ethnic Han	77	90.6%
Tibetan	7	8.2%
Tujia	1	1.2%
Semiology		
Convulsive SE	65	76.5%
Myoclonic SE	1	1.1%
Focal motor	8	9.4%
Tonic status	1	1.1%
Hyperkinetic status	1	1.1%
NCSE with coma	5	5.8%
NCSE without coma	4	4.7%
Etiology		
Acute	45	52.9%
Remote	8	9.4%
Progressive	10	11.8%
Unknown	22	25%
Duration of SE		
<1 h	68	80%
1 h-24 h	12	14.1%
>24 h	5	5.9%
Refractory status epilepticus	14	16.8%
EEG		
Non-specific slow wave	38	44.7%
Focal slow waves	5	5.9%
Diffuse slow waves	10	11.8%
Epileptic discharge	24	28.2%
Normal	8	9.4%
Cerebrospinal fluid		
Elevated protein	25	29.4%
Elevated cell count	21	24.7%
Elevated intracranial pressure	13	15.3%
Positive cerebrospinal fluid or serum autoimmune brain antibody	13	15.3%
Therapy		
Benzodiazepines	31	36.5%
ADEs	78	91.8%
Anesthesia	14	16.5%
Immunomodulatory	21	24.7%

TABLE 1 (Continued)

Items	Cases	Constituent ratio
ICU	52	61.2%
Tracheal intubation	22	25.9%
Co-infection	30	35.3%
Mean stay in hospital	12.38 + 9.439	

Note: Immunomodulatory therapy includes hormone therapy, immunoglobulin therapy, plasma exchange and so on.

Abbreviations: ADEs, Antiepileptic drugs; EEG, Electroencephalogram; NCSE, nonconvulsive status epilepticus; SE, status epilepticus.

with NOSE.14 (16.8%) patients had refractory persistent epilepsy (RSE), with only three having new onset persistent epilepsy (NORSE). The characteristics of the patients are detailed in Table 1.

The etiologies of NOSE were classified as acute (52.9%), progressive (9.4%), remote (11.8%), and unknown (25.8%). The predominant known etiology was CNS infection in 20 patients (23.5%), followed by autoimmune diseases in 12 patients (14.1%), and cerebrovascular disease in 10 patients (11.8%). The distribution of specific etiologies of NOSE was statistically significant between ages ( $P < .05$ ). In those younger than 60 years, the main known etiology was CNS infection, followed by autoimmune-related diseases. As for those elderly people  $\geq 60$  years, the main known etiology remained CNS infections and cerebrovascular diseases. The etiology is further detailed in Figures 1 and 2.

Apart from that, we compared older and younger patients with NOSE, who differed in imaging, indicating a statistical difference with normal imaging being more common in younger patients than in older patients (43.6% vs 6.7%,  $P < .001$ ). Short-term outcomes in patients with NOSE differed in age-related subgroups: 56% of older patients and 44% of younger patients showed a poor prognosis ( $P = .01$ ). Regarding treatment, no differences were observed. Further clinical details of NOSE in older and younger patients are shown in Table 2. We discovered in our retrospective analysis that 25 individuals had poor functional outcomes. According to Table 3, patients who had tracheal intubation ( $P = .001$ ) or an infection ( $P = .002$ ) were more likely to experience poor results. Age, co-infection and tracheal intubation continued to be significant predictors of neurocognitive outcomes in the logistic regression model with age (OR = 3.5, 95% CI = 0.108-0.758,  $P = .012$ ), co-infection (OR = 4.5, 95% CI = 0.083-0.599,  $P = .003$ ), and tracheal intubation (OR = 6.318, 95% CI = 0.060-0.204,  $P = .011$ ) shown in Table 4.

## Etiology of NOSE

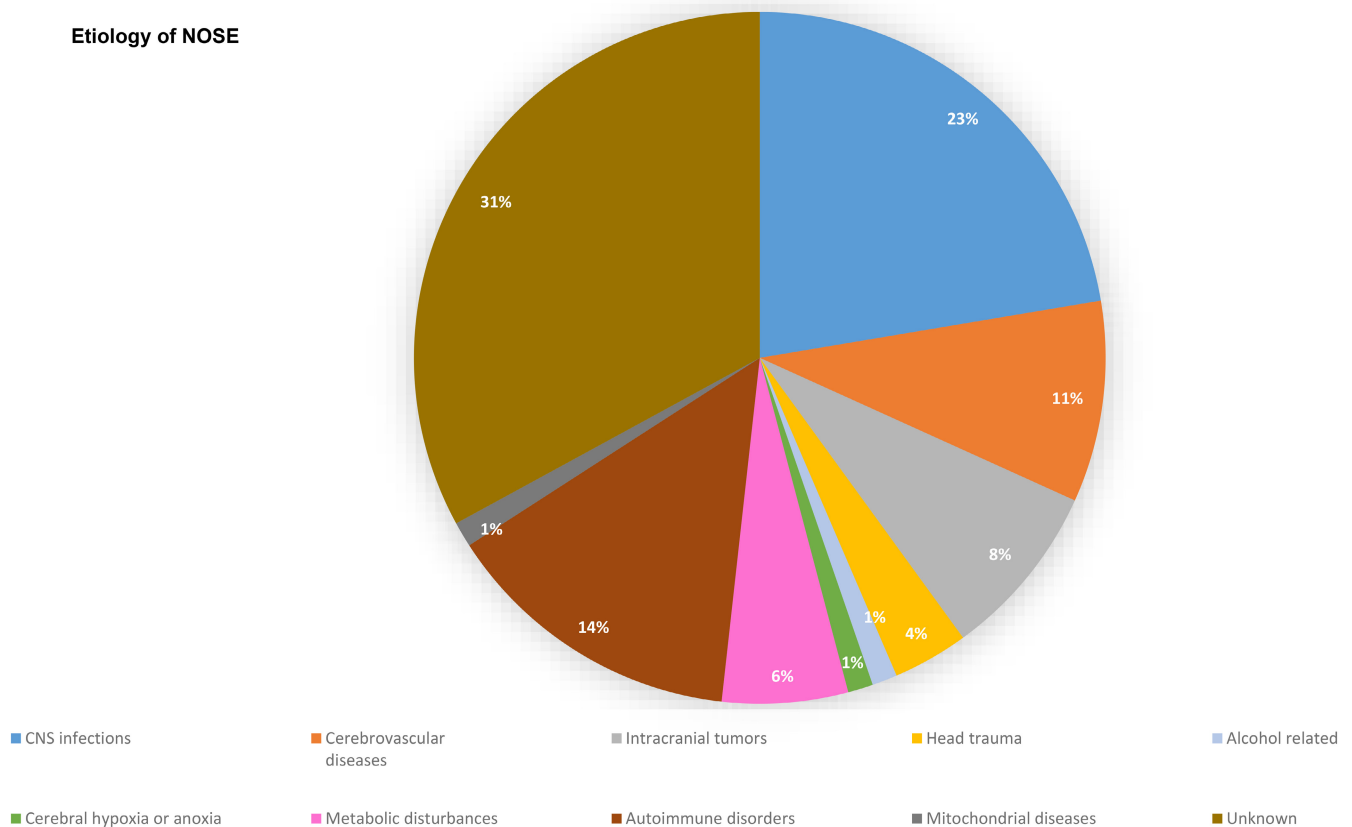


FIGURE 1 Etiology of new-onset status epilepticus (NOSE)

## 4 | DISCUSSION

Our study demonstrated clinical characteristics and outcomes of patients with SE at first seizure.

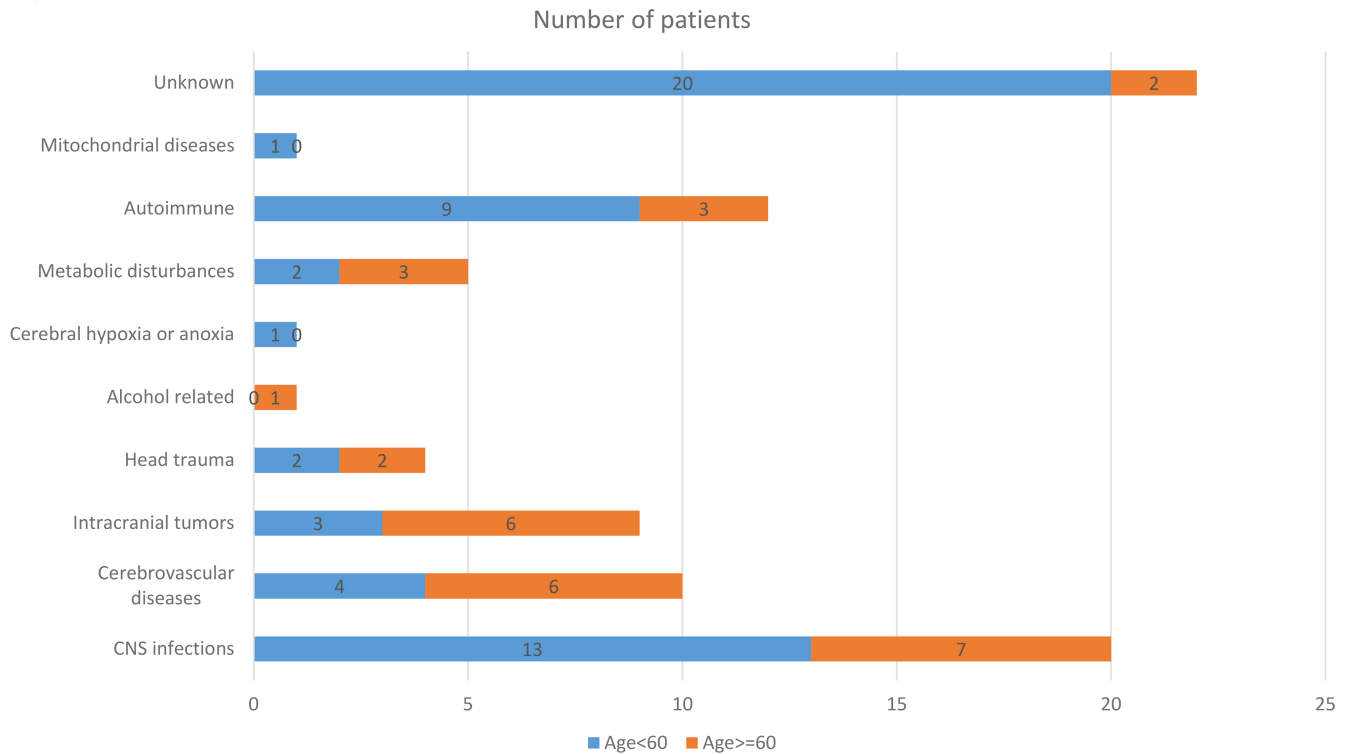
In our study, we found a higher percentage of patients with acute symptomatic etiology, followed by unknown etiology. Besides, CNS infection was found to be the main known cause, unlike previous studies that considered cerebrovascular accidents as their most common cause.<sup>10,20</sup> Also, it is worth mentioning that autoimmune-related diseases, especially autoimmune encephalitis, have become one of the increasingly recognized causes of NOSE,<sup>2,16,21,22</sup> which is in line with our findings.

The current studies suggested that the initial treatment strategy includes simultaneous assessment and management of airway, breathing, and circulation, seizure abortive drug treatment, screening for the cause of SE, and immediate treatment of life-threatening causes of SE.<sup>1,23</sup> Other than that, the treatment of persistent epilepsy due to autoimmune encephalitis is different. We found that immunomodulatory therapies have different therapeutic responses and outcomes depending on the underlying cause, the type of autoantibodies and their neuronal targets, and intracellular or cell surface antigens in patients with autoimmune SE.<sup>24,25</sup> Several studies have found that

immunotherapy improves the prognosis of patients with these autoimmune diseases, with more than 50% reduction in seizure frequency at the first follow-up.<sup>26</sup> Our study indicated the use of antiepileptic drugs accounted for 72.9%, Benzodiazepine for 36.5%, and immunotherapy for 22.4%, but we did not find a correlation between drugs and healing, which may be due to the relatively small sample size of our study. Additionally, in our study, we found that those NOSE patients with unknown etiology still did not undergo standardized autoimmune-related antibody testing and we may have missed some diagnostic evidence, which may lead to untimely treatment.

In addition, the characteristics of elderly and young NOSE patients are different. Previous studies have shown that etiology is age-dependent, which is consistent with our findings in our study.<sup>11,13</sup> The most common etiology of the older NOSE patients is acute, while younger patients with NOSE are still unknown, followed by CNS infection. In terms of imaging, there are some disparities between older people with NOSE and younger people with NOSE, with older people having more strong signals on the medial temporal lobe and younger people with NOSE having normal imaging. Studies conducted recently have not shown comparable results, which may require further data to confirm in the future.

### The specific distribution of etiology among the younger and older patient



**FIGURE 2** The specific distribution of etiology among the younger and older patient

In contrast to previous studies of large samples of NOSE that found mortality rates of approximately 24.9%,<sup>3</sup> with advances in treatment, recent related studies have found mortality rates of approximately 7.6%-15%.<sup>11,13</sup> In our study, the mortality rate of NOSE in this study was only about 1.1%, with 29.4% of patients having a poor prognosis and the rest having a good prognosis. Age, co-morbid infections in the course of the disease, and use of mechanical ventilation were associated with poor prognosis, whereas in other studies the poor prognostic factors were the age of the patient, duration of SE, and etiology of the disease.<sup>12,27-32</sup> The lower mortality and the poor prognostic factors of our study could be due to the smaller sample size of patients studied and shorter follow-up.

## 5 | LIMITATION

Our study is an observational and retrospective non-interventional study with underlying problems. First, because we collected patient data from an electronic medical record system, the system may have searched only for patients with a first diagnosis of SE and patients who missed SE as an alternative diagnosis, or patients with SE but recorded as having seizures, resulting in an incomplete

sample. Therefore, we should broaden our focus before excluding them in accordance with our criteria. Second, we need to exclude the SE patients who did not complete EEG or imaging thus losing another part of the data and may not identify some patients with NCSE. Third, we collected only a small sample in our hospital, and future improvements could be achieved by collecting patient data from other hospitals to reduce sampling error.

## 6 | CONCLUSION

Our study elucidates the clinical characteristics, the etiologies, and the outcome of the NOSE in our hospital. The primary etiologies of NOSE are still acute symptomatic, though the central systemic infection has become the most common cause which remained unlikely before. Although specific cause differs in various age groups, a common and rising cause is autoimmune, which we should keep a watchful eye on it, due to its curability from previous research. Furthermore, patients with NOSE should be tested for autoimmune antibodies as early as possible to prepare for the follow-up treatment. Poor outcomes in NOSE are related to the use of mechanical ventilation which might remind us that after-care is crucial for people's prognosis. Undoubtedly,

**TABLE 2** Difference in new-onset status epilepticus of younger (<60 years) compared to older ( $\geq 60$  years) patients

	Younger patients	Older patients	P value
Sex (Male/Female)	34/21	15/15	.292
Outcome (Favorable/Unfavorable)	44/11	16/14	.01
<b>Semiology</b>			
Convulsive SE	44 (80%)	21 (70%)	.628
Myoclonic SE	1 (1.8%)	0	
Focal motor	4 (7.2%)	4 (13.3%)	
Hyperkinetic status	1 (1.8%)	0	
Tonic status	0	1 (3.3)	
NCSE with coma	3 (5.5%)	2 (6.7%)	
NCSE without coma	2 (3.6%)	2 (6.7%)	
<b>Etiology</b>			
Acute	28 (51%)	17 (56.7%)	.005
Remote	4 (7.2%)	4 (13.3%)	
Progressive	3 (5.5%)	7 (23.3%)	
Unknown	20 (36.4%)	2 (6.7%)	
<b>Duration of SE</b>			
<1 h	44 (80%)	24 (80%)	.966
1 h-24 h	8 (14.5%)	4 (13.3%)	
>24 h	3 (5.5%)	2 (6.7%)	
<b>EEG</b>			
Non-specific slow wave	23 (41.8%)	15 (50%)	.478
Focal slow waves	3 (5.5%)	2 (6.7%)	
Diffuse slow waves	5 (9.1%)	5 (16.7%)	
Epileptic discharge	19 (34.5%)	5 (16.7%)	
Normal	5 (9.1%)	3 (10%)	
<b>Cerebrospinal fluid</b>			
Elevated protein	15 (27.2%)	10 (33.3%)	.226
Elevated cell count	15 (27.2%)	6 (20%)	.498
Elevated cerebrospinal fluid pressure	11 (20%)	3 (10%)	.359
Positive cerebrospinal fluid or serum autoimmune brain antibody	9 (16.4%)	4 (13.3%)	.193
<b>Imaging</b>			
Unilateral temporal lobe lesions	8 (14.5%)	6 (20%)	.001*
Bilateral temporal lobe lesions	11 (20%)	6 (20%)	
Lesions of other intracranial structures	10 (18.2%)	16 (53.3%)	
Normal	24 (43.6%)	2 (6.7%)	
<b>Therapy</b>			
Benzodiazepines	16 (29.1%)	15 (50%)	.056
ADEs	52 (94.5%)	26 (86.7%)	.207
Anesthesia	8 (14.5%)	6 (20%)	.517
Immunomodulatory	16 (29.1%)	5 (16.7%)	.204
Refractory status epilepticus	7 (12.7%)	7 (23.3%)	.208
Tracheal intubation	13 (23.6%)	9 (30%)	.522
ICU	30 (54.5%)	21 (70%)	.165
Co-infection	14 (25.5%)	16 (53.3%)	.10
Mean stay in hospital	11.64 $\pm$ 8.44	13.73 $\pm$ 11.07	.187

Abbreviations: ADEs, antiepileptic drugs; CI, confidence interval; NCSE, nonconvulsive status epilepticus; OR, odds ratio; SE, status epilepticus.

\* $P < .05$ .

	Favorable	Unfavorable	P value
Sex (Male/Female)	36/24	13/12	.496
Age (<60y/> = 60y)	44/16	11/14	.010*
Ethnic			
Ethnic Han	54 (90%)	23 (92%)	.204
Tibetan	6 (10%)	1 (4%)	
Tujia	0	1 (4%)	
Semiology			
Convulsive SE	45 (75%)	20 (80%)	.963
Myoclonic SE	1 (1.7%)	0	
Focal motor	5 (8.3%)	3 (12%)	
Hyperkinetic status	1 (1.7%)	0	
Tonic status	1 (1.7%)	0	
NCSE with coma	3 (5%)	1 (4%)	
NCSE without coma	4 (6.7%)	1 (4%)	
Etiology			
Acute	30 (50%)	15 (60%)	.288
Remote	5 (8.3%)	3 (12%)	
Progressive	6 (12%)	4 (16%)	
Unknown	19 (31.7%)	3 (12%)	
Duration of SE			
<1 h	50 (83.3%)	18 (72%)	.269
1 h-24 h	8 (13.3%)	4 (16%)	
>24 h	2 (3.3%)	3 (12%)	
Refractory status epilepticus	4 (6.7%)	10 (40%)	.940
EEG			
Non-specific slow wave	25 (41.7%)	13 (52%)	.087
Focal slow waves	4 (6.7%)	1 (4%)	
Diffuse slow waves	4 (6.7%)	6 (24%)	
Epileptic discharge	20 (33.3%)	4 (16%)	
Normal	7 (11.7%)	1 (4%)	
Cerebrospinal fluid Elevated protein	17 (28.3%)	8 (32%)	.906
Cerebrospinal fluid Elevated cell count	12 (2%)	9 (36%)	.286
Cerebrospinal fluid Elevated cerebrospinal fluid pressure	11 (18.3%)	3 (12%)	.177
Positive cerebrospinal fluid or serum autoimmune brain antibody	9 (15%)	4 (16%)	.711
Imaging			
Unilateral temporal lobe lesions	9 (15%)	5 (20%)	.227
Bilateral temporal lobe lesions	12 (20%)	5 (20%)	
Lesions of other intracranial structures	15 (25%)	11 (44%)	
Normal	22 (36.7%)	4 (16%)	
Therapy			
Benzodiazepines	19 (31.7%)	12 (48%)	.154
ADEs	55 (91.7%)	23 (92%)	.959
Anesthesia	7 (11.7%)	7 (28%)	.064
Immunomodulatory	15 (25%)	6 (24%)	.922
ICU	30 (50%)	21 (84%)	.165
Co-infections	15 (25%)	15 (60%)	.002*
Tracheal intubation	13 (21.7%)	9 (36%)	.001*
Mean stay in hospital	10.80 ± 6.76	16.16 ± 13.35	.316

TABLE 3 Factors influencing the prognosis of new-onset status epilepticus

Abbreviations: ADEs, Antiepileptic drugs; CI, confidence interval; NCSE, nonconvulsive status epilepticus; OR, odds ratio; SE, status epilepticus.

\* $P < .05$ .



TABLE 4 Predictors of outcomes

Factors	Partial regression coefficients	Wald $\chi^2$	OR	95% CI	P value
Age	-1.193	4.456	3.5	0.108-0.758	.012*
Co-infections	-0.657	1.215	4.5	0.083-0.599	.003*
Tracheal intubation	-1.590	6.429	6.318	0.060-0.204	.011*

Abbreviations: CI, confidence interval; OR, odds ratio.

\* $P < .05$ .

the evaluation of outcome predictors remains an ongoing challenge in NOSE. Further prospective studies should be carried out which might guide clinicians in their therapeutic decision and management.

Our study elucidated the clinical characteristics, the etiologies, and the prognosis of the NOSE in our hospital. The primary etiologies of NOSE remain acute symptomatic; though the central systemic infection has become the most common cause. Specific causes differ in various age groups. Autoimmune disease is a frequent and aggravating factor that, according to earlier studies, is curable. However, in our study, we discovered that many patients had not yet undergone screening for cerebrospinal fluid autoimmune-related antibodies, particularly in those with unknown causes. As a result, some patients who may have had autoimmune-related SE may have gone undiagnosed and untreated. In the future, to prepare for the follow-up treatment, patients with NOSE should be examined for autoimmune antibodies as soon as feasible. In addition, co-infection and the use of mechanical ventilation are associated with poor outcomes in NOSE, which serves as a reminder that early infection prevention and efficient care are crucial for the improvement of the patient's condition. Undoubtedly, age is an irreversible risk factor in the evaluation of outcome predictors. In addition to this, the evaluation of outcome predictors remains an ongoing challenge in NOSE. Further prospective studies should be carried out which might guide clinicians in their therapeutic decision and management.

### CONFLICT OF INTEREST

This work was supported by the Scientific Research Fund of the Sichuan Academy of Medical Sciences & Sichuan Provincial People's Hospital (2021LY28) and the Scientific Research Fund of the Science & Technology Department of Sichuan Province (2022YFS0317). None of the authors has any conflict of interest to disclose. We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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