

Early seizures in stroke – frequency, risk factors, and effect on patient outcomes in a tertiary center in Saudi Arabia

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ABSTRACT

الأهداف: تحديد تكرر وعوامل الخطر ونتائج النوبة المبكرة (ES) بعد السكتة الدماغية في مجموعة سعودية.

المنهجية: أجريت دراسة بأثر رجعي في مدينة الملك عبد العزيز الطبية، الرياض، المملكة العربية السعودية. اشتملت الدراسة على جميع مرضى السكتة الدماغية سواء أصيبوا بالسكتة الدماغية الأولى أو المتكررة من فبراير 2016م إلى ديسمبر 2017م. قمنا بتحليل البيانات باستخدام الإصدار 9.4 من برنامج SAS.

النتائج: من بين 665 مريضاً 456 (68.6%) ذكور و 564 (85.2%) سعوديون. كان متوسط عمر المجموعة 60.6 ± 12.6 عام. ظهر ES لدى 51 (7.7%) مريض، والتي كانت أكثر شيوعاً عند النساء ($p=0.0123$). ارتبط فقدان الوعي ($p=0.0402$) والارتباك ($p < 0.0007$) ب ES، في حين أن الضعف أحادي الجانب ($p=0.001$) والتنميل أحادي الجانب ($p=0.0317$) عند التقديم قلل من مخاطر ES. لم تختلف عوامل الخطر الوبائية بين المرضى الذين يعانون من ES وغير المصابين. ارتبطت السكتة النزفية مع ES ($p=0.0054$)، في حين كان المرضى الذين يعانون من مرض الأوعية الدموية الصغيرة أقل عرضة لتطور ES ($p=0.0013$). كان المرضى الذين يعانون من ES لديهم سكتة دماغية أكثر شدة (NIHSS $p=0.0139$) ($p > 5$)، ودخول المزيد من وحدات العناية المركزة (49% مقابل 26.2%؛ $p=0.0005$)، وطول مدة الإقامة في المستشفى (44.9 يوماً مقابل 24.9 يوماً؛ $p=0.0018$)، ومعدلات أعلى للمضاعفات المرتبطة بالسكتة الدماغية (مثل السكتة الدماغية المتكررة، والانسداد الرئوي، والالتهابات المكتسبة من المستشفى، والحاجة إلى ثقب القصبه الهوائية ووضع أنبوب فغر المعدة) ($p \leq 0.0001$)، ومن المرجح أن تكون أكثر إعاقة شديدة تعرف باسم mRS 3–5 عند التفريغ (47.7% مقابل 40.8%؛ $p=0.0055$) أو الموت في المستشفى (11.8% مقابل 4.6%؛ $p \leq 0.0001$).

الخلاصة: كانت ES بعد السكتة الدماغية شائعة في مجموعتنا. كانت زيادة شدة السكتة الدماغية والارتباك منبئات مستقلة لـ ES. ارتبطت ES مع معدلات أعلى من المضاعفات داخل المستشفى، وطول مدة الإقامة في المستشفى، ونتائج أسوأ عند الخروج.

Objectives: To determine the frequency, risk factors, and outcomes of Early seizure (ES) after stroke in a Saudi cohort.

Methods: A retrospective study was conducted in King Abdulaziz Medical City, Riyadh, KSA. All stroke

patients whether they had first or recurrent stroke were included from February 2016 to December 2017. Data were analyzed using the SAS software version 9.4.

Results: Out of 665 patients, 456 (68.6%) were males and 564 (85.2%) were Saudis; the cohort's mean age was 60.6 ± 12.6 years. Fifty-one (7.7%) patients had ES, which were more common in women ($p=0.0123$). Loss of consciousness ($p=0.0402$) and confusion ($p < 0.0007$) were associated with ES, whereas unilateral weakness ($p=0.001$) and unilateral numbness ($p=0.0317$) at presentation decreased the risk of ES. Vascular risk factors did not differ between patients with and without ES. Hemorrhagic stroke was associated with ES ($p=0.0054$), whereas patients with small vessel disease were less likely to develop ES ($p=0.0013$). Patients with ES had more severe stroke (NIHSS > 5) ($p=0.0139$), more ICU admissions (49% vs. 26.2%; $p=0.0005$), longer length of hospital stay (44.9 days vs. 24.9 days; $p=0.0018$), higher rates of stroke-related complications (e.g. recurrent stroke, pulmonary embolism, hospital acquired infections, and need for tracheostomy and gastrostomy tube placement) ($p \leq 0.0001$), and were likely to be more severely disabled defined as mRS 3–5 at discharge (47.7% vs. 40.8%; $p=0.0055$) or to die in hospital (11.8% vs. 4.6%; $p \leq 0.0001$).

Conclusion: The ES after stroke were common in our cohort. Increased stroke severity and confusion were independent predictors of ES. The ES were associated with higher rates of in-hospital complications, longer length of hospital stay, and worse outcomes at discharge.

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Stroke is one of the common causes of symptomatic seizures in the elderly. Post-stroke seizures (PSS) are commonly classified into early seizures (ES) and late seizures (LS).¹ No specific cut-off point that delineates ES has been agreed upon, but most studies arbitrarily define ES as those that occur within 7–14 days of incident stroke.^{1,2} The PSS occurring beyond this period are considered LS. The incidence rate for ES after stroke is not well established, although it has been reported to be 2%–33%.^{2,3} A recent meta-analysis has found that ES incidence after ischemic stroke is 3.3%, whereas the LS incidence rate was found to be 18 per 1000 person-years.¹ A study investigating seizures that occurred within 24 h of stroke onset has found an incidence of 3.1% in more than 6,000 stroke patients.³ Not all patients with PSS develop epilepsy. Approximately 2–4% of patients develop epilepsy after stroke.⁴

Data on the risk factors for ES after stroke are inconsistent. In some studies, cardioembolic stroke, cortical location of stroke, hemorrhagic transformation of ischemic stroke, increased severity of stroke, and history of coronary artery disease or atrial fibrillation were found to be the predictors of ES after stroke.^{2,4,5} The ES after stroke are associated with increased morbidity and mortality, and can affect the functional independence of stroke patients, resulting in poorer quality of life, as well as in increased resource utilization.^{3,6} However, evidence-based data on PSS and guidelines on PSS management remain lacking.⁶

The PSS are not uncommon and are broadly classified into ES and LS. Not all patients with ES develop post-stroke epilepsy.⁶ The pathophysiological mechanisms underlying ES and LS are widely different. Having a specific time window to define ES from LS is crucial, as this may help in predicting post-stroke epilepsy. In the acute phase of stroke, ionic shifts, excitotoxicity neurotransmitters, metabolic dysfunction, and changes in coagulation cascade can all contribute to the early onset of seizure after an ischemic event.^{7,8} By contrast, LS results from persistent structural changes and gliosis that occur in the late phase of stroke, causing disruption in neuronal firing, circuit dysfunction, and eventually epileptogenic changes.^{7,8}

The PSS has been studied in different populations; considering the observed variations in incidence, risk factors, and outcomes of PSS, we find it important to investigate this condition in the Saudi population. Our study aimed to determine the frequency of post stroke seizures in our population, and to identify the predictors of ES. It also looked at the outcome of these patients. To the best of our knowledge, this is the earliest study

to report data on ES after stroke in a Saudi cohort, and it may be useful in planning future large-scale studies on ES prevention and management.

Methods. We retrospectively reviewed the records of all patients admitted to the acute stroke unit of King Abdulaziz Medical City, MNGHA, Riyadh, Saudi Arabia, from February 2016 to December 2017. This study (RSS19/051/R) was approved by the Institutional Review Board (IRB) of the King Abdullah International Medical Research Center (KAIMRC) on July 15, 2019. Informed consent was waived by the IRB given the retrospective nature of data collection, as no patient identifiers were included in the data.

This study employed a consecutive non-random sampling method. Adult male and female patients aged 18 years and above and diagnosed with ischemic or hemorrhagic stroke were included. Patients with a history of epilepsy, patients experiencing transient ischemic attack and cerebral vein thrombosis, and patients with a final diagnosis other than stroke (e.g., tumor, infection, and functional disorder) were excluded.

Demographic, clinical, and radiological data were collected from electronic health records (BestCare system). An ES is defined as a seizure that occurred within 7 days of incident stroke. Strokes were classified into ischemic and hemorrhagic strokes. Ischemic strokes were further classified based on the TOAST classification.⁹ The TOAST classification characterizes strokes into stroke due to large-artery atherosclerosis, stroke due to cardioembolism, stroke due to small-vessel occlusion, stroke due to other determined etiology, and stroke of undetermined etiology (when there are 2 or more causes identified, the diagnostic evaluation is negative or the diagnostic evaluation is incomplete). Stroke severity was assessed using the National Institute of Health Stroke Scale (NIHSS), whereas stroke outcomes were evaluated using the modified Rankin Scale (mRS). Moreover, length of hospital stay and stay in the intensive care unit (ICU) were determined. Vascular risk factors and stroke-related complications were identified from hospital records. Discharge disposition and discharge outcomes were obtained from discharge summaries.

Data were analyzed using SAS version 9.4. Frequencies and percentages were calculated for the categorical data. Means with standard deviations were calculated for the numerical data. Univariate analyses were performed using Chi-square test and t-test. Multivariate analysis was applied using multivariable logistic regression analysis, when indicated. Odds ratios (ORs) with 95% confidence intervals (CIs) were

expressed relative to a reference (baseline) category. A p -value of <0.05 was considered statistically significant.

Results. A total of 665 stroke patients were studied, 456 (68.6%) of whom were males and 564 (85.2%) were Saudis. The cohort's mean age was 60.6 ± 12.6 years (age range was 18 to 96 years). The ES occurred in 51 patients (7.7%). The mean age of patients with ES was 60.5 ± 13.8 years. More women (24/209) had developed ES after stroke than men (27/456) ($p=0.0123$). Table 1 presents the age, gender distribution, and vascular risk factors of the patients.

Patients with and without ES had similar clinical presentations (Table 1). The ES patients were more

likely to present with loss of consciousness (19.6% vs. 10.3%; $p=0.0402$) and confusion (23.5% vs. 8.8%; $p=0.0007$), whereas those who presented with unilateral weakness (47.1% vs. 69.5%; $p=0.0010$) or unilateral numbness (7.8% vs. 20.2%; $p=0.0317$) were less likely to experience ES. The time from symptom onset to presentation did not differ between the two groups ($p=0.2399$). The vascular risk factors were also similar between the groups.

The incidence of ES did not differ between those who had a first stroke (66% vs. 65%; $p=0.8858$) and those with a recurrent stroke (33.3% vs. 35.2%; $p=0.8009$). Patients who had hemorrhagic strokes (25.5%) were more likely to develop ES than those

Table 1 - Demographic profile, stroke presentation, timing of presentation, and vascular risk factors in patients with and without early seizure (ES).

Demographic variables category	Total (n=665)	Patients with ES (n=51, 7.7%) n (%)	Patients without ES (n=614, 92.3%) n (%)	P-value
<i>Gender</i>				
Male	456 (68.6)	27 (52.9)	429 (69.9)	0.0123
Female	209 (31.4)	24 (47.1)	185 (30.1)	
Mean age (in years)	60.6 ± 12.6	60.5 ± 13.8	60.6 ± 12.5	0.7442
<i>Nationality</i>				
Saudi	564 (85.2)	49 (96.1)	515 (84.3)	0.0227
Non-Saudi	98 (14.8)	2 (3.9)	96 (15.7)	
<i>Presenting complaint</i>				
Unilateral weakness	451 (67.8)	24 (47.1)	427 (69.5)	0.001
Unilateral numbness	128 (19.3)	4 (7.8)	124 (20.2)	0.0317
Loss of consciousness	73 (11)	10 (19.6)	63 (10.3)	0.0402
Sudden/Thunderclap headache	17 (2.7)	3 (5.9)	14 (2.3)	0.1173
Headache	105 (15.8)	11 (21.6)	94 (15.3)	0.2388
Loss of vision	15 (2.3)	2 (3.9)	13 (2.1)	0.4044
Change in speech	292 (43.9)	22 (43.1)	270 (44.0)	0.9079
Loss of speech	57 (8.6)	3 (5.9)	54 (8.8)	0.4753
Balance problems	24 (3.6)	1 (2.0)	23 (3.8)	0.5113
Double vision	38 (5.7)	1 (2.0)	37 (6.0)	0.2294
Confusion	66 (9.9)	12 (23.5)	54 (8.8)	0.0007
<i>Duration of symptoms</i>				
<3 h	176 (26.6)	14 (27.5)	162 (26.5)	0.2399
3–6 h	72 (10.9)	6 (11.8)	66 (10.8)	
6–24 h	116 (17.5)	4 (7.8)	112 (18.3)	
>24 h	228 (34.4)	18 (35.3)	210 (34.3)	
No data	71 (10.7)	9 (17.7)	62 (10.1)	
<i>Vascular risk factors</i>				
Hypertension	497 (74.7)	38 (74.5)	459 (74.8)	0.9690
Diabetes mellitus	435 (65.4)	31 (60.8)	404 (65.8)	0.4695
Dyslipidemia	175 (26.3)	9 (17.7)	166 (27.0)	0.1434
Atrial fibrillation	43 (6.5)	3 (5.9)	40 (6.5)	0.8600
Smoking	95 (14.3)	8 (15.7)	87 (14.2)	0.7661
Prior stroke	154 (23.2)	13 (25.5)	141 (23.0)	0.6811
Ischemic heart disease	92 (13.9)	7 (13.7)	85 (13.9)	0.9813

Table 2 - Stroke types and severity at the time of presentation in patients with and without early seizure (ES).

Variable category	Total (n=665)	Patients with ES (n=51, 7.7%)	Patients without ES (n=614, 92.3%)	P-value
	n (%)			
<i>Number of stroke</i>				
First stroke	421 (65.1)	33 (66.0)	388 (65.0)	0.8858
Recurrent	210 (35.1)	15 (33.3)	195 (35.2)	0.8009
Missing data	34			
<i>Stroke type</i>				
Transient Ischemic Attack	2 (0.3)	0	2 (0.3)	0.6831
Large artery atherosclerosis	208 (31.3)	16 (31.4)	192 (31.3)	0.9879
Small vessel disease	180 (27.1)	4 (7.8)	176 (28.7)	0.0013
Cardioembolic stroke	97 (14.6)	9 (17.7)	88 (14.3)	0.5193
Stroke of undetermined etiology	60 (9.0)	4 (7.8)	56 (9.1)	0.7596
Stroke of other determined etiology	1 (0.2)	0	1 (0.2)	0.7730
Hemorrhagic stroke	86 (13.0)	13 (25.5)	73 (11.9)	0.0054
Missing data	31 (4.6)	5 (10)	26 (4.2)	
<i>Stroke severity at presentation</i>				
Mild (NIHSS <5)	349 (59.3)	18 (42.9)	346 (60.5)	
Moderate (NIHSS 5–5)	177 (28.8)	14 (33.3)	163 (28.5)	0.0139
Severe (NIHSS 16–25)	61 (9.9)	7 (16.7)	54 (9.4)	
Very severe (NIHSS >25)	12 (2.0)	3 (7.14)	9 (1.6)	

NIHSS – National Institute of Health Stroke Scale Score

who had ischemic strokes (11.9%) ($p=0.0054$). Patients with small vessel disease were less likely to experience ES (7.8% vs. 28.7%; $p=0.0013$). Table 2 summarizes the TOAST classification of strokes in patients with and without ES. Patients with ES had a more severe stroke (NIHSS >5) at presentation than those without ES (57.1% vs. 39.5%; $p=0.013$).

Nearly two-thirds (36 of the 51) patients with ES had seizures on the first day after stroke. Patients with ES were more likely to be admitted to the ICU ($p=0.0005$). Moreover, ICU stay was longer in patients with ES than in those without ES (18.9 days vs. 10.6 days), although the difference was not significant. The total length of hospital stay was significantly longer in patients with ES than in patients without ES (26.7 days vs. 13.7 days; $p=0.0018$). The incidence rates of stroke-related complications were higher in patients with ES (72.6%) than in those without ES (40.7%), ($p\leq 0.0001$). Recurrent strokes ($p=0.0174$), pulmonary embolism ($p=0.0059$), pneumonia ($p\leq 0.0001$), urinary tract infection ($p\leq 0.0001$), and sepsis ($p=0.0002$) were more common in patients with ES. Moreover, the patients with ES were more likely to have tracheostomy tube placement ($p=0.0056$), gastrostomy tube

placement ($p=0.0142$), bed sores ($p=0.0013$), and brain edema ($p=0.0104$). Patients with ES were more likely to be more severely disabled (mRS 3–5) at discharge ($p=0.0055$) or to die in hospital [6 (11.8%) vs. 28 (4.6%); ($p\leq 0.0001$)] (Table 3).

Multivariate analysis showed that greater severity of stroke (OR 1.064; 95% CI: 1.023–1.107) and confusion at presentation (OR 2.405; 95% CI: 1.067–5.421) were independent risk factors for ES and that unilateral weakness at presentation (OR 0.434; 95% CI: 0.223–0.845) was inversely related to ES.

Discussion. Our study found an incidence of 7.7% for ES after stroke. Most of the patients had seizures within first day of incident stroke. Age had no significant effect on the incidence of ES, however, in our cohort female gender was associated with higher risk of ES. Hemorrhagic strokes were associated with higher risk of ES in our cohort, whereas patients who had stroke due to small vessel disease were less likely to develop ES. Patients with more severe strokes were more likely to have ES. Patients who developed early seizures were more likely to have stroke related complications and longer length of hospital stay. The ES were associated with poorer outcome at discharge.

Table 3 - Length of stay, stroke-related complications, and outcomes in patients with and without early seizure (ES).

Variable - Category	Total (n=665)	Patients with ES	Patients without ES	P-value
		(n=51, 7.7%)	(n=614, 92.3%)	
		n (%)		
ICU admission	185 (27.9)	25 (49.0)	160 (26.2)	0.0005
ICU length of stay (in days)	11.7	18.9±41.5	10.6±16.1	0.4740
Hospital length of stay (in days)	14.7	26.7±44.9	13.7±24.9	0.0018
<i>Stroke-related complications</i>				
Any complication	287 (43.2)	37 (72.6)	250 (40.7)	<0.0001
Recurrent stroke	41 (6.2)	7 (14)	34 (5.6)	0.0174
Deep vein thrombosis	11 (1.7)	1 (2)	10 (1.6)	0.8469
Pulmonary embolism	5 (0.8)	2 (4)	3 (0.5)	0.0059
Myocardial infarction	5 (0.8)	0	5 (0.8)	0.5208
Pneumonia	57 (8.6)	12 (24)	45 (7.4)	<0.0001
Urinary tract infection	58 (8.9)	14 (28)	44 (7.3)	<0.0001
Sepsis	40 (6.1)	9 (18)	31 (5.1)	0.0002
Tracheostomy tube placement	36 (5.5)	7 (14)	29 (4.8)	0.0056
Gastrostomy tube placement	40 (6.1)	7 (14)	33 (5.4)	0.0142
Bed sores	4 (0.6)	2 (4)	2 (0.3)	0.0013
Brain edema	46 (7.1)	8 (16)	38 (6.3)	0.0104
<i>Discharge modified Rankin Scale score</i>				
0–2 (independent)	326 (55.2)	18 (40.9)	308 (56.3)	0.0055
3–5 (dependent)	244 (41.3)	21 (47.7)	223 (40.8)	
Death	34 (5.1)	6 (11.8)	28 (4.6)	
Missing data	61 (9.2)	6 (11.8)	55 (9.0)	
<i>Discharge disposition</i>				
Discharged home	513 (77.4)	31 (60.8)	482 (78.8)	<0.0001
Discharged to other facility	87 (13.1)	10 (19.6)	77 (12.5)	
Death	34 (5.1)	6 (11.8)	28 (4.6)	
Missing data	31 (4.7)	4 (7.8)	27 (4.4)	

Table 4 - Direct and inverse associations of early seizures after multivariate analysis.

Effect	OR	95% CI	P-value
NIHSS score	1.064	(1.023, 1.107)	0.0020
Confusion	2.405	(1.067, 5.421)	0.0343
Unilateral weakness	0.434	(0.223, 0.845)	0.0141

*The probability modeled was “stroke with early seizures”

The PPS incidence rates vary widely, ranging from 2% to 33%,² although most of the published data suggests rates between 3% to 7%.^{10,11} A meta-analysis involving more than 100,000 stroke patients has reported an incidence rate of 7%,¹⁰ whereas a more recent analysis involving ischemic stroke patients only has reported an incidence rate of 3.3%.¹ Our study included both ischemic and hemorrhagic stroke patients, and ES after stroke was seen in 7.7% of our cohort. Most of these patients had a seizure within the first 24 h of stroke onset. When we grouped our patients

according to age (<60 years and >60 years), we found that age did not affect the ES incidence. Meanwhile, previous data have not shown a consistent correlation between ES and gender. A few studies and a meta-analysis have shown that PSS incidence did not differ in relation to gender.^{2,11} A multicenter study on the other hand found that female gender is associated with PSS,¹² and a different study showed a male predominance of seizure recurrence in patients with PSS.¹³ We found that the female gender is associated with a higher risk of ES after stroke. A recent study found female gender, and younger age as risk factors for refractory post-stroke epilepsy.¹⁴ There is no clear explanation of why females can have higher risk of ES after stroke or more refractory PSS, however, previous findings suggest that women have poorer outcomes after stroke than men due to differences in sex hormone, coagulation profile, and social and lifestyle factors.¹⁵ This needs to be further studied in larger studies to understand the relationship of gender to poststroke ES and PSS. One of the possible explanation of higher ES in women in

our cohort, is our small sample size, where women represented less than a third of the patients. Timing of presentation from stroke onset and vascular risk factors did not differ between the patients with and without ES in our cohort, consistent with the published data.^{2,4} One study has found that a history of atrial fibrillation is a predictor of PSS recurrence.¹³ Data on the initial presentation of stroke and the risk of PSS are limited. We found that confusion and loss of consciousness at presentation are associated with ES, and this finding may be explained by cortical involvement or by increased severity of stroke. A recent study involving continuous electroencephalogram (cEEG) monitoring has reported an incidence rate of 12% for non-convulsive status epilepticus in patients with neurological deterioration after stroke and an incidence rate of 44% for epileptic activities in stroke patients who underwent EEG recording due to deteriorating level of consciousness.¹⁶ Patients who present with confusion or altered level of consciousness were likely to experience epileptic activity at the onset of stroke. One interesting finding regarding clinical presentation is the inverse relationship between unilateral focal weakness or numbness and ES. In our cohort, the patients who presented with unilateral weakness were less likely to experience ES after stroke. Another study has found an inverse relationship between motor weakness and PSS.¹² Although there is no clear explanation for this finding, more strokes due to small vessel disease or lacunar strokes are possibly associated with focal weakness or numbness without showing cortical symptoms and signs.

No difference was found between the first or recurrent stroke and the risk of ES in our cohort. Patients with hemorrhagic strokes are more likely to experience ES after stroke compared with ischemic stroke patients,^{3,6,11} which is concordant with our findings. In our cohort, ES was more common in hemorrhagic stroke patients. A few studies have found an inverse relationship between ES and small vessel disease,^{3,5} whereas other studies did not find any difference in ES incidence in relation to ischemic stroke subtype.⁴ We also found an inverse relationship between small vessel disease and ES incidence. Cortical localization of stroke and hemorrhagic conversion of stroke have also been found to be predictors of ES after stroke;^{5,11} however, we did not investigate these radiological features in our population.

Stroke severity has consistently been found to be a predictor of PSS.^{2,5-6,11} We also found higher stroke severity at presentation to be associated with increased risk of ES. Patients who had an NIHSS score of >5 at

presentation were more likely to experience ES than those with a lower NIHSS score. The days immediately following a stroke are considered crucial, as most complications that occur on these days often result in worse clinical outcomes. The incidence rates of stroke-related complications were higher in ES patients than in those without ES, consistent with previous literature.¹⁷ Nearly three-fourths of our patients experienced some kind of stroke-related complications, of which the most significant were pneumonia, urinary tract infection, sepsis, and pulmonary embolism. Recurrent stroke was also more common in patients who had ES. Patients with ES were more likely to undergo tracheostomy tube placement and gastrostomy tube placement and to develop bed sores. Moreover, patients with ES were more likely to require ICU admission and to have longer length of hospital stay compared with those without ES.

Outcomes of stroke patients after an ES have been reported in a number of studies. Although some earlier studies have reported no association between ES and disability or mortality,^{2,18-19} most of the recent studies and meta-analyses have suggested poorer outcomes in patients with ES.^{4,12,20-22} In our cohort, those with ES had higher morbidity and mortality, were more likely to be disabled, had more than twice the risk of in-hospital mortality, and were less likely to be discharged home than those without ES.

Our study has certain limitations, including its retrospective design and the lack of continuous EEG monitoring within the first 24 h. The incidence of ES could have been underestimated, as some ES might have gone unrecognized due to the lack of detailed documentation of patient status and continuous EEG monitoring, especially within the first 24 h. Another limitation is the small size of our cohort, which may limit the strength of the results. Some data on outcomes were unavailable in the records. Additionally, we did not follow the patients longitudinally; hence, long-term outcomes could not be determined. Our study is a single-center hospital-based investigation, which reduces the generalizability of the results.

Conclusion. The ES after stroke were common in our cohort. Higher stroke severity and presentation with confusion were independent risk factors for ES after stroke. A negative association was observed between focal weakness at presentation and ES after stroke. The ES after stroke was associated with higher in-hospital complications, longer ICU stay, and worse outcomes at discharge. In the future, with the use of the identified predictive factors, patients at higher risk of ES may serve as candidates for randomized intervention trials for ES prevention, as well as PSS.

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