



ORIGINAL ARTICLE

Seizures in the Emergency Department: clinical and diagnostic data from a series of 153 patients

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KEYWORDS

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Abstract

Introduction: Seizures are a frequent reason for admission to emergency departments and require early, precise diagnosis and treatment. The objective of this study was to describe the clinical and prognostic characteristics of a series of patients with seizures attended at our hospital's emergency department.

Methods: We performed a retrospective, observational study of all patients with seizures who were admitted to our hospital's emergency department and attended by the on-call neurology service between February and August 2017.

Results: We included 153 patients, representing 9.9% of all neurological emergency department admissions. The median age was 58 years, 52.3% of patients were women, and 51% had history of epilepsy. Onset was focal in 82.4% of cases, and the most frequent aetiology was cerebrovascular disease (24.2%). Twelve patients (7.8%) developed status epilepticus, which was associated with higher scores on the ADAN scale ($P < .001$) and with history of refractory epilepsy ($P = .002$). The in-hospital mortality rate was 3.7%, and in-hospital mortality was associated with older age ($P = .049$) and status epilepticus ($P = .018$). Eighty percent of patients with no history of epilepsy were diagnosed with epilepsy

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PALABRAS CLAVE

Crisis epilépticas;
Estatus epiléptico;
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at the emergency department; all started treatment. The kappa coefficient for epilepsy diagnosis in the emergency department compared to diagnosis after one year of follow-up by the epilepsy unit was 0.45 (diagnosis was modified in 20% of patients).

Conclusions: Seizures are a frequent neurological emergency with potential complications and considerable morbidity and mortality rates. In patients with no known history of epilepsy, the condition may be diagnosed in the emergency department, but follow-up at specialised epilepsy units is recommended.

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Crisis epilépticas en Urgencias: aspectos clínicos y diagnósticos de una serie de 153 pacientes

Resumen

Introducción: Las crisis epilépticas son un motivo de ingreso frecuente en urgencias y requieren una actuación diagnóstico-terapéutica precoz y precisa. Nuestro objetivo fue describir las características clínico-evolutivas de una serie de pacientes con crisis epilépticas atendidos en Urgencias.

Métodos: Estudio observacional retrospectivo de todos los pacientes con crisis epilépticas que ingresaron en Urgencias y fueron atendidos por neurología de guardia, de febrero a agosto de 2017.

Resultados: Se incluyeron 153 pacientes, correspondientes al 9,9% del total de urgencias neurológicas. La mediana de edad fue 58 años, el 52,3% fueron mujeres, y el 51% tenía antecedente de epilepsia. El 82,4% de las crisis tuvo un inicio focal y la etiología más frecuente fue la patología cerebrovascular (24,2%). Doce pacientes se complicaron con estatus epiléptico (7,8%), lo que se relacionó con mayor puntuación en la escala ADAN ($p < 0,001$) y con antecedente de epilepsia refractaria ($p = 0,002$). La mortalidad hospitalaria fue del 3,7%; se asoció a mayor edad ($p = 0,049$) y a estatus epiléptico ($p = 0,018$). El 80% de los pacientes sin epilepsia conocida recibió el diagnóstico de epilepsia en Urgencias, todos iniciaron tratamiento. El índice kappa de concordancia para el diagnóstico de epilepsia en Urgencias comparado con el diagnóstico tras un año de seguimiento en la Unidad de epilepsia fue 0,45 (se modificó el diagnóstico en el 20% de los pacientes).

Conclusiones: Las crisis epilépticas constituyen una urgencia neurológica frecuente, con potenciales complicaciones y una morbimortalidad relevante. En pacientes sin epilepsia conocida, es apropiado realizar el diagnóstico de epilepsia en urgencias, pero es recomendable un seguimiento posterior en consultas especializadas.

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Introduction

Epileptic seizures are a frequent reason for consultation at the emergency department, accounting for 1%-3% of all admissions.^{1,2} In patients with known epilepsy, seizures may require urgent assessment due to changes in frequency or intensity or association with such complications as status epilepticus or brain trauma, while seizures in patients without known epilepsy may constitute a symptom of a potentially severe disease.³ The emergency management of seizures is costly for healthcare systems, with an estimated annual expenditure of 88.2 million pounds in the United Kingdom.² In addition to the economic cost, seizures require specialised medical care and complementary tests to reach a precise diagnosis; this is particularly relevant in patients without known epilepsy, as it will determine treatment and prognosis.

Diagnosing epilepsy at the emergency department is plausible, taking into account the latest (2014) definition of the International

League Against Epilepsy (ILAE), which allows for diagnosis of the disease in patients presenting a single seizure if the risk of recurrence is similar to the general recurrence risk after 2 seizures (at least 60%).⁴ Early diagnosis at the emergency department is associated with a range of advantages for patient outcomes, but also has personal and legal implications that must be taken into account. Concordance between diagnosis of epilepsy established at the emergency department and in subsequent follow-up consultations at specialised epilepsy clinics is not always perfect, with the diagnosis being changed after one year of follow-up in up to 25% of patients diagnosed at the emergency department.⁵ Furthermore, the initial treatment with antiepileptic drugs (AED) is not always well tolerated, and up to 90% of patients may present relevant adverse effects.^{6,7}

The objectives of this study were to describe the clinical and prognostic characteristics of a series of patients with seizures attended by the on-call neurology service at the emergency department and to identify factors associated with hospitalisation and such

complications as status epilepticus. With regard to status epilepticus, we analysed the functioning of the ADAN scale (acronym for abnormal speech, eye deviation, automatism, and number of seizures), a recently developed tool for predicting the progression of a seizure to status epilepticus.⁸ Finally, for patients who were admitted for first seizures, we evaluated the concordance between diagnosis of epilepsy at the emergency department and the diagnosis established at subsequent follow-up consultations at the epilepsy unit, and identified the factors associated with that diagnosis.

Material and methods

Study design and patient selection

We conducted an observational retrospective study of all patients aged ≥ 18 years who were admitted to the emergency department at Hospital Clínico San Carlos (Madrid, Spain) with a diagnosis of epileptic seizure or status epilepticus and attended by the on-call neurology service between February and August 2017, inclusive. Seizures, status epilepticus, and epilepsy were diagnosed according to the latest ILAE definitions.^{4,9,10} Data were gathered from the database of patients attended by the on-call neurology service. Hospital Clínico San Carlos is a tertiary-level hospital located in the city of Madrid, and serves a population of 370 501, as of 2017. The study was approved by the hospital's Clinical Research Ethics Committee (project code 18-406E).

Data collection

The following data were recorded for each case: (1) demographic data: age and sex; (2) baseline status: modified Rankin Scale (mRS) score¹¹; (3) history and type of epilepsy; (4) emergency department admission data: type and number of seizures recorded in the medical history reported by the patient and/or their companions, aetiology, trigger factors; (5) ADAN scale score⁸: a numeric scale from 0 to 5, in which patients score one point each for the presence of abnormal speech, eye deviation, automatism, or 2 seizures, and 2 points for more than 2 seizures, with ≤ 1 point considered to indicate low risk, 2 moderate risk, and > 2 high risk, with a cut-off point of > 1 to predict progression to status epilepticus; (6) results of complementary tests performed at the emergency department: head CT, brain MRI, EEG, or video-EEG; and (7) new diagnosis of epilepsy at the emergency department in patients with no previous diagnosis of the disease.

The dependent or prognostic variables recorded were: (1) hospitalisation; (2) progression to status epilepticus; (3) death during hospitalisation; (4) mRS score at discharge; and (5) whether diagnosis of epilepsy had changed at one year of follow-up by the epilepsy unit, for patients diagnosed with epilepsy at the emergency department.

We also recorded the total number of patients admitted to the emergency department during the inclusion period, the number of patients diagnosed with seizures or status epilepticus who were admitted to the emergency department during that period, and the total number of patients attended by the on-call neurology service during that period.

Statistical analysis

We initially performed a univariate analysis of the sample. Qualitative variables are expressed as absolute frequencies and percentages. Quantitative variables were not normally distributed, and are therefore expressed as median and interquartile range (IQR). To compare qualitative variables, we used the chi-square test or the Fisher exact test, when more than 25% of the expected values were below 5. The Wilcoxon test was used to compare quantitative variables.

Table 1 Aetiology of seizures.

Aetiology	Frequency (no. cases)
Cerebrovascular disease	24.2% (n = 37)
Undetermined	23.5% (n = 36)
Tumour	10.5% (n = 16)
Idiopathic generalised epilepsy	9.8% (n = 15)
Autoimmune diseases (MS, anti-NMDAR encephalitis, etc)	5.9% (n = 9)
Hippocampal sclerosis	4.6% (n = 7)
CNS infection	3.9% (n = 6)
Neurodegenerative disease	3.9% (n = 6)
Malformations of cortical development	3.3% (n = 5)
Brain trauma	3.3% (n = 5)
Excessive alcohol consumption	3.3% (n = 5)
Hypoxic encephalopathy	2.0% (n = 3)
Chromosomalopathies and genetic disorders	2.0% (n = 3)

CNS: central nervous system; MS: multiple sclerosis; NMDAR: N-methyl-D-aspartate receptor.

bles. To compare a qualitative against a quantitative variable, we used the Mann-Whitney U test or the Kruskal-Wallis H test, depending on the number of possible categories for the qualitative variable. Inter-rater agreement for diagnosis of epilepsy was analysed using the Cohen kappa coefficient: values range from -1 to 1 , with values < 0 indicating disagreement, $0-0.20$ slight agreement, $0.21-0.40$ fair agreement, $0.41-0.60$ moderate agreement, $0.61-0.80$ substantial agreement, and $0.81-1.00$ almost perfect agreement. The significance threshold was set at $P < .05$ for all tests. Data processing and analysis were performed using the IBM SPSS statistics software, version 23.

Results

During the 6-month inclusion period a total of 61 250 patients were admitted to the emergency department, with a total of 162 epileptic seizures (0.3%), 94.4% of which (n = 153) were attended by the on-call neurology service. The most frequent neurological emergencies were cerebrovascular disease (31.5%, n = 490), headache (12.8%, n = 200), and seizures (9.9%, n = 153).

The 153 patients with seizures attended by the on-call neurology service were included in the study. The median age (Q_1-Q_3) in our sample was 58 years (45-78), and 52.3% of patients (n = 80) were women. Seventy-eight patients (51%) had history of epilepsy, which was focal in 80.8% of cases (n = 63) and generalised in 19.2% (n = 15). Median mRS score at baseline was 0 (0-3), and 73.5% of patients (n = 111) were independent in the basic activities of daily living (mRS ≤ 2). The median ADAN scale score was 1 point (0-2).

Seizure onset was focal in 82.4% of cases (n = 126) and generalised in 17.6% (n = 27). In the latter group, seizures were tonic-clonic in 81.5% of cases (n = 22), tonic in 14.8% (n = 4), and absence seizures in 3.7% (n = 1). In patients with focal-onset seizures, awareness was preserved in 38.8% of cases (n = 49) and impaired in 29.3% (n = 38); focal seizures progressed to bilateral tonic-clonic seizures in 30.9% of cases (n = 39). Focal seizures with preserved awareness most frequently presented with language alterations (53.1%; n = 26). The most frequent aetiology was cerebrovascular disease (24.2% of cases; n = 37); 23.5% of seizures were of undetermined origin (n = 36; Table 1).

Brain neuroimaging studies were performed at the emergency department in 101 cases (92 CT studies and 9 MRI studies), including

all 75 patients without known history of epilepsy; focal brain lesions were identified in 48% of these patients ($n = 36$). Of the 78 patients with history of epilepsy, 34.7% ($n = 26$) underwent imaging studies; these studies were requested due to persistence of focal neurological signs after seizure resolution in 57.7% of cases ($n = 15$) and due to an increase in seizure frequency with regards to usual frequency in 42.3% ($n = 11$). Sixty-two patients (40.5%) underwent EEG studies at the emergency department, including 39 video-EEG studies of longer than one hour duration. Thirty-two patients undergoing EEG (51.6%) did not have known history of epilepsy. Of all EEG studies performed ($n = 62$), 17 patients (27.4%) presented seizures with ictal EEG patterns, and the remaining 27 (43.5%) presented interictal epileptiform activity. Of the 32 patients without history of epilepsy who underwent EEG studies, epileptiform activity was recorded in 10 (31.2%); this activity was observed in video-EEG studies of longer than one hour duration in 8 cases.

Regarding prognosis, 32.7% of our sample ($n = 50$) presented medical complications, though not all required hospitalisation. The most frequent complications were urinary tract infections ($n = 15$), followed by status epilepticus ($n = 12$) and respiratory infections ($n = 10$). Thirty-two percent of patients ($n = 49$) required hospitalisation, 61.2% of whom ($n = 30$) did not have known history of epilepsy. Three patients were admitted directly to the intensive care unit. Median duration of hospitalisation was 8 days (3-14). Six patients died during hospitalisation; therefore, the mortality rate in our sample was 3.9%. All patient deaths were related to the aetiology of the seizure: advanced cancer in 3 cases, stroke in 2, and progressive multifocal leukoencephalopathy in one patient. Among survivors, the median time from onset to recovery of baseline status was 20.0 hours (7.7-52.5).

New diagnosis of epilepsy at the emergency department

Of the 75 patients without known history of epilepsy, 80% ($n = 60$) were diagnosed with epilepsy at the emergency department by the on-call neurology service, and all started AED treatment after discharge from the emergency department. The AEDs used were levetiracetam in 21 cases, lacosamide in 20, lamotrigine in 8, eslicarbazepine in 7, and perampanel, zonisamide, topiramate, and brivaracetam in one case each. Twenty-five of these patients were followed up at our centre's specialised epilepsy unit, while the remaining patients belonged to other healthcare districts or were followed up at other centres.

Of the 25 patients followed up at our centre's epilepsy unit, 88% ($n = 22$) were diagnosed with epilepsy at the emergency department by the on-call neurology department. The first consultation at the epilepsy unit occurred a median of 29 days (Q_1 - Q_3 , 8-61) after discharge; at one year of follow-up, the diagnosis of epilepsy was the same in 17 of the 22 patients, and changed in 5. The alternative diagnoses were convulsive syncope in 3 cases, transient global amnesia in one, and visual migraine aura in one. The 3 patients who were not diagnosed with epilepsy at the emergency department also had not been diagnosed with epilepsy at one year of follow-up by the epilepsy unit (Table 2). If we treat diagnosis by the epilepsy unit as the gold standard, diagnosis at the emergency department after a first seizure presents sensitivity of 100%, specificity of 37.5%, positive predictive value of 77.3%, and negative predictive value of 100%. The kappa coefficient for inter-rater agreement was 0.45. Thus, the diagnosis of epilepsy established at the emergency department was changed during follow-up in 5 cases (20%).

Correct diagnosis of epilepsy at the emergency department was associated with EEG recording of a seizure or epileptiform activity, in patients undergoing EEG ($P = .042$), and no other qualitative (sex, focal onset, focal lesions identified in head CT studies, history of similar episodes) or quantitative variable (age, mRS, or seizure duration until full recovery).

Table 2 Concordance between diagnosis of epilepsy established at the emergency department and at one year of follow-up by the epilepsy unit, in patients without known history of epilepsy and followed up at the epilepsy unit ($n = 25$).

		Emergency department		
Epilepsy unit		No	Yes	
	No	3	5	8
	Yes	0	17	17
		3	22	25

Association between status epilepticus and other variables

Progression to status epilepticus was more frequent in patients with refractory epilepsy (33.0%, vs 3.6% in patients without refractory epilepsy; $P = .002$).

Median ADAN scale score⁸ was 3 (Q_1 - Q_3 : 2-4) in patients who progressed to status epilepticus, significantly higher than in patients who did not progress to status epilepticus (1; Q_1 - Q_3 : 0-2; $P = .001$). Qualitative analysis of the 3 ADAN scale categories established by the creators of the scale (0-1, low risk of progression to status epilepticus; 2, moderate risk; > 2, high risk) showed that patients with high risk more frequently progressed to status epilepticus than patients with moderate risk, who in turn presented less frequent progression to status epilepticus than those with low risk (36.8% vs 15.2% vs 0%, respectively; $P < .001$). We also observed an association with progression to status epilepticus when the analysis included the cut-off point of ADAN > 1 (moderate-high risk; cut-off point established by the authors of the scale as a predictor of status epilepticus): 23.1% of patients with ADAN scale scores > 1 progressed to status, compared to 0% of those with lower scores ($P < .001$). Median ADAN scale scores were also higher in patients who were hospitalised (2; Q_1 - Q_3 : 1-2) than in those who were not (1; Q_1 - Q_3 : 0-1; $P < .001$) and in those who died (2; Q_1 - Q_3 : 1-4) than in patients who survived (1; Q_1 - Q_3 : 0-2; $P = .048$).

Patients with status epilepticus presented an in-hospital mortality rate of 20%, significantly higher than in the remaining patients (2.8%; $P = .018$).

None of the other qualitative or quantitative variables were associated with progression to status epilepticus.

Association between mortality and other variables

Patients who died were older than those who survived (median age of 78.5 vs 58.7; $P = .049$) and more frequently progressed to status epilepticus (33.3% vs 6.8%; $P = .018$). We also observed a trend towards longer median seizure duration until recovery of the baseline status in this group (120 minutes vs 17 minutes; $P = .068$).

Mortality was not associated with any other qualitative or quantitative variable.

Association between hospitalisation and other variables

The factors associated with higher likelihood of hospitalisation were older age (68.2 years in patients who were admitted vs 54.9 in those who were not; $P < .001$), seizure duration until recovery of the baseline status (30 minutes vs 15 minutes; $P = .011$), and lack of history of epilepsy (40.5% vs 24.4%; $P = .033$).

Discussion

Our results show that epileptic seizures are a common reason for admission to emergency departments, constituting the third leading neurological emergency at our centre. Furthermore, epilepsy is a potentially severe disease: some patients progress to status epilepticus or present associated medical complications, and in other cases seizures were associated with permanent brain injury and even death. At our centre, the on-call neurology service assesses all patients admitted to the emergency department due to seizures; neurological assessment is unnecessary in few cases (5.6% in our sample), when seizures occur in patients with known epilepsy and present a fast and complete recovery, with modifiable trigger factors (eg, a missed dose of a medication).

High ADAN scale scores were associated with progression to status epilepticus, both quantitatively and qualitatively, with the cut-off point (> 1) and the 3 risk categories established by the authors of the scale⁸. Compared to the original study, the proportion of patients in our sample who progressed to status epilepticus was slightly lower in the moderate- and high-risk categories. Higher ADAN scale scores in our patients were also associated with a higher mortality rate and increased likelihood of hospitalisation, although the scale was not developed with these variables in mind.

In the analysis of concordance between diagnosis of epilepsy at the emergency department and after one year of follow-up by the specialised epilepsy unit, we found a kappa index of 0.45. This indicates moderate agreement, which may be insufficient, given that epilepsy is a chronic disease with potential psychosocial repercussions. The low agreement is explained by low specificity (37.5%), as the diagnosis of epilepsy had changed at one year of follow-up in 5 cases (20%). However, sensitivity was 100%, as all patients with epilepsy were diagnosed at the emergency department and started treatment, and no patients were diagnosed at follow-up consultations who had not previously been diagnosed at the emergency department (negative predictive value of 100%). We believe that, overall, the possibility of diagnosing epilepsy in patients without history of epilepsy and attending the emergency department due to a first seizure had more positive than negative repercussions at our centre, facilitating treatment onset and seizure prevention.¹² Furthermore, early implementation of follow-up at specialised consultations may mitigate the negative effects of misdiagnosis at the emergency department, thanks to the greater diagnostic accuracy.^{6,13}

Accurate diagnosis of epilepsy at the emergency department was associated with detection of epileptiform activity or seizure in EEG studies, as reported in previous studies.^{5,14} This reaffirms the importance of early EEG recording, particularly with prolonged monitoring, as was the case in our study. However, no other factors were associated with diagnosis of epilepsy. Identification of focal lesions in CT studies was not associated with increased diagnostic accuracy; similar findings have also been reported for MRI studies.⁵ This may be explained by the fact that small-vessel disease was not considered a focal lesion, although both can cause vascular epilepsy,¹⁵ potentially reducing the strength of the association between focal lesions and diagnosis of epilepsy in patients with the disease.

The limitations of our study include its retrospective design, which reduces the accuracy of data collection and may have biased the results. The low frequency of progressive events (death, progression to status epilepticus) and the study's single-centre design may limit the reproducibility of our results, although they are consistent with the findings of similar studies published previously. The lack of follow-up data for some of our patients may also have led to a bias in the analysis of prognostic variables. All these limitations may be addressed in new prospective studies ensuring that patients are followed up and that data are collected for all the necessary variables.

In conclusion, seizures are a frequent reason for admission to emergency departments and are associated with considerable rates of morbidity and mortality due to potentially severe causes and such complications as status epilepticus. Regarding status epilepticus, high ADAN scale scores are associated with greater risk of progression to status epilepticus, which the scale was designed to predict. Our results also suggest that epilepsy in patients without known history of epilepsy may be diagnosed at the emergency department; subsequent follow-up of these patients at a specialised epilepsy unit is recommended.

Conflicts of interest

The authors have no conflicts of interest to declare.

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References

- Pallin DJ, Goldstein JN, Moussally JS, Pelletier AJ, Green AR, Camargo CA. Seizure visits in US emergency departments: epidemiology and potential disparities in care. *Int J Emerg Med*. 2008;1:97–105.
- Dickson JM, Jacques R, Reuber M, Hick J, Campbell MJ, Morley R, Grünwald RA. Emergency hospital care for adults with suspected seizures in the NHS in England 2007–2013: a cross-sectional study. *BMJ Open*. 2018;8:e023352.
- Foreman B, Hirsch LJ. Epilepsy emergencies: diagnosis and management. *Neurol Clin*. 2012;30:11–41.
- Fisher RS, Acevedo C, Arzimanoglou A, Bogacz A, Cross JH, Elger CE, et al. ILAE official report: a practical clinical definition of epilepsy. *Epilepsia*. 2014;55:475–82.
- Fonseca Hernández E, Olivé Gadea M, Requena Ruiz M, Quintana M, Santamarina Pérez E, Abaira Del Fresno L, et al. Reliability of the early syndromic diagnosis in adults with new-onset epileptic seizures: a retrospective study of 116 patients attended in the emergency room. *Seizure*. 2018;61:158–63.
- Perucca P, Carter J, Vahle V, Gilliam FG. Adverse antiepileptic drug effects: toward a clinically and neurobiologically relevant taxonomy. *Neurology*. 2009;72:1223–9.
- Sharma S, Kwan P. The safety of treating newly diagnosed epilepsy. *Expert Opin Drug Saf*. 2019;18:273–83.
- Requena M, Fonseca E, Olivé M, Abaira L, Quintana M, Mazuela G, et al. The ADAN Scale: a proposed scale for prehospital use to identify status epilepticus. *Eur J Neurol*. 2019;26:760–855.
- Fisher RS, Cross JH, French JA, Higurashi N, Hirsch E, Jansen FE, et al. Operational classification of seizure types by the International League Against Epilepsy: Position Paper of the ILAE Commission for Classification and Terminology. *Epilepsia*. 2017;58:522–30.
- Trinka E, Cock H, Hesdorffer D, Rossetti AO, Scheffer IE, Shinnar S, et al. A definition and classification of status epilepticus — report of the ILAE Task Force on Classification of Status Epilepticus. *Epilepsia*. 2015;56:1515–23.
- Berzina G, Sveen U, Paanalahti M, Sunnerhagen KS. Analyzing the modified Rankin Scale using concepts of the International Classification of Functioning, Disability, and Health. *Eur J Phys Rehabil Med*. 2016;52:203–13.

12. Fernández Alonso C, Alonso Avilés R, Liñán López M, González Martínez F, Fuentes Ferre M, Gros Bañeres B. Registro ACESUR: atención de pacientes adultos con crisis epilépticas en servicios de urgencias: diferencias entre primer episodio y recurrencia. *Emergencias*. 2019;31:91–8.
13. Oto MM. The misdiagnosis of epilepsy: appraising risks and managing uncertainty. *Seizure*. 2017;44:143–6.
14. Sierra-Marcos A, Toledo M, Quintana M, Edo MC, Centeno M, Santamarina E, et al. Diagnosis of epileptic syndrome after a new onset seizure and its correlation at long-term follow-up: longitudinal study of 131 patients from the emergency room. *Epilepsy Res*. 2011;97:30–6.
15. Pohlmann-Eden B, Newton M. First seizure: EEG and neuroimaging following an epileptic seizure. *Epilepsia*. 2008;49:19–25.