Abnormal Electroencephalography in First Unprovoked Seizure in Rajavithi Hospital

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Background: *Electroencephalography (EEG) has an important role in epilepsy diagnosis, classification of epilepsy syndrome, lesion localization, and prediction of seizure recurrence, but no study of EEG in the first unprovoked seizure had been carried out in Rajavithi Hospital prior to the current one.*

Objective: *The present research aimed to find the prevalence of abnormal EEG in the first unprovoked seizure and the prevalence of abnormal EEG in partial seizure and generalized seizure.*

Material and Method: *This was a retrospective study of 28 adult patients who presented with first unprovoked seizure. EEG was performed in all patients and baseline characteristics were recorded.*

Results: *Of the 28 patients with first unprovoked seizure, abnormal EEG was found in 16 patients (57.41%). 95%CI of the prevalence of abnormal EEG was 37.60-76.68%. EEG abnormalities were found in 7 patients (46.7%) who had partial seizure, and 8 patients (53.3%) who had generalized seizure. Eight patients (28.6%) had epileptiform discharges. The patients who were taking medication for underlying diseases and patients with abnormal neurological examinations were associated with a statistically significant higher risk of EEG abnormality (OR 6.43, 95%CI 1.05-39.33, p = 0.044, and OR 13.2, 95%CI 1.24-140.68, p = 0.027, respectively).*

Conclusion: *Abnormal EEG was detected in more than half of the patients with first unprovoked seizure, which is comparable to previous studies. EEG should be considered for all patients with first unprovoked seizure.*

Keywords: *Abnormal electroencephalography, First unprovoked seizure*

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Epileptic seizure is a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain. The definition of epilepsy, which is a common neurological disease, requires the occurrence of at least one epileptic seizure[1]. In developing countries, the prevalence of epilepsy is higher than in developed countries. In rural Thailand, the prevalence is 7.2 per 1,000[2]. The incidence of single unprovoked seizures is 23-61/ 100,000 person-years. As with epilepsy in general, single unprovoked seizures predominate in men and in patients less than 12 months old and older than 65 years[3]. Seizure or epilepsy diagnosis relies mainly on patients' medical history. EEG has an important role in epilepsy diagnosis, classification of epilepsy syndrome, lesion localization, and prediction of seizure recurrence. The risk of recurrence after a first seizure is about 51%, and etiology of seizure and EEG were the strongest predictors of recurrence[4]. The purpose of the present research was to assess the prevalence of abnormal electroencephalo-graphy in first unprovoked seizure in Rajavithi Hospital.

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Material and Method

The present study was approved by the research ethics committee of Rajavithi Hospital. The primary research question was to find the prevalence of abnormal EEG in first unprovoked seizure. The second research question was to determine the prevalence of abnormal EEG in the first unprovoked generalized seizure and partial seizure. The author identified the records of patients aged ≥ 18 years, who were examined in Rajavithi Hospital with a diagnosis of presumed first seizure during the period October 2006 to January 2012. Diagnosis was based on the clinical circumstances of the event. All patients underwent general medical and neurological examinations, and hematological and biochemical screening tests. Brain imaging, either CT brain or MRI brain, was done in 23 patients. Of the 41 patients with first seizure, 13 patients had precipitating

causes such as hyponatremia, drug-induced seizure, and alcohol-withdrawal seizure. Twenty-eight patients with first unprovoked seizures were defined as a single seizure (or series of seizures occurring within a 24-hour period), without precipitating causes. A 16-channel routine awake EEG was performed on a 19-channel EEG with a channel ECG on Nicolet machine. The electrodes were placed according to the 10/20 system with referential and bipolar montages. The EEGs were recorded for at least 30 min and included 3 min of hyperventilation and photic stimulation in the different frequencies (in the patients who were able to cooperate). Each EEG tracing was interpreted by a neurologist and the EEGs were coded as normal or abnormal. Abnormal EEGs were described either as epileptiform discharges, or focal or nonspecific (generalized) slow waves. Seizures were classified by a neurologist, according to eyewitnesses' and the patient's descriptions, as partial, partial with secondary generalization, or generalized seizure. Patients who had partial seizure and partial seizure with generalization were defined as partial seizure.

Statistical analysis

Descriptive results of continuous variables were expressed as mean $\pm$ SD, median (min-max). For categorical variables, statistical analysis was performed using Chi-square or Fisher's exact tests to compare the number of cases with abnormal EEG between patients with partial seizure and those with generalized seizure. For comparison between variables and EEG findings, crude odds ratio and 95% confidence interval were performed. The p-value of less than 0.05 was set for statistical significance.

Results

There were 28 patients with first unprovoked seizure in the present study. Abnormal EEG was found in 16 patients (57.41%). 95%CI of the prevalence of abnormal EEG was 37.60-76.68%. There were 8 patients (28.6%) with epileptiform discharges, 6 patients (21.4%) with non-specific or generalized slow waves, and 2 patients (7.1%) with beta activities. The results of the EEG findings are shown in Fig. 1. EEG abnormalities were found in 46.7% of patients with partial seizure, and in 53.3% of patients with generalized seizure. Causes of seizure in the patients who had partial seizure with abnormal EEG were encephalitis, temporal lobe epilepsy, hypoxic ischemic encephalopathy, mitochondrial encephalopathy, and idiopathic. Causes of seizure in the patients who had generalized seizure with abnormal EEG were idiopathic, encephalitis, acute stroke, and brain tumor. The most common cause in the patients who had first unprovoked seizure with normal EEG was idiopathic (7 patients). Two patients presented with status epilepticus which was caused by acute stroke and hypoxic ischemic encephalopathy. Both had nonspecific slow waves. The baseline characteristics of the patients are shown in Table 1.

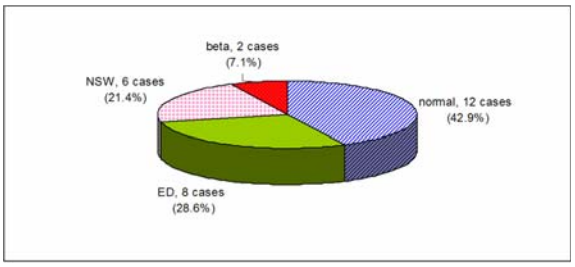

Fig. 1 Number of cases with different types of EEG. ED = epileptic discharge, NSW = nonspecific or generalized slow waves, Beta = beta activities

The mean age of the patients in the present study was 52.26 $\pm$ 16.31 years. Median time of EEG after seizure onset was 12 days (range 1-120 days). Age $\geq$ 45 years, male sex, underlying disease, number of seizures, partial seizure type, abnormal brain imaging, time interval between seizure and EEG less than 10 days, and seizure recurrence all proved to be not associated with statistically significant higher risk of EEG abnormalities. The patients who had underlying diseases and had received antiepileptic drugs were more likely to have an abnormal EEG; however, these figures were not statistically significant (p-values = 0.243 and 0.063 in patients who had underlying diseases and received antiepileptic drugs respectively). Patients who were taking medication for underlying diseases and had abnormal neurological examinations were associated with a statistically significant higher risk of EEG abnormality (OR 6.43, 95%CI 1.05-39.33, p = 0.044, and OR 13.2, 95%CI 1.24-140.68, p = 0.027 respectively). The duration of follow-up in the present study ranged from 0 days to more than 3 years.

CT brain and/or brain MRI were done in 23 patients (82.14%). Brain imagings were abnormal in 16 patients (69.57%) including focal cerebral atrophy in 2 (12.5%), generalized brain atrophy in 1 (6.25%), focal hypodensity lesions in 4 (25%), cerebral atrophy with multiple cerebral infarction in 3 (18.75%), generalized brain swelling in 1 (6.25%), meningeal enhancement in 1 (6.25%), hyperintense signal at temporal lobe in 3 (18.75%), temporal lobe tumor in 1 (6.25%).

Table 1. Baseline characteristics of the patients

Characteristics(n_{normal}:$n_{abnormal}$)	Normal EEG (n = 12)	Abnormal EEG (n = 16)	Total (n = 28)	Crude OR (95%CI)	p-value
Age (years:mean ± SD)	49.33 ± 14.85	54.44 ± 17.47	52.25 ± 16.31		
≥45 years	7 (58.3%)	13 (81.3%)		3.10 (0.57-16.96)	0.231
Sex					0.445
Female	7 (58.3%)	7 (43.8%)	14 (50%)	1	
Male	5 (41.7%)	9 (56.2%)	14 (50%)	1.80 (0.40-8.18)	
Underlying disease	6 (50%)	12 (75%)	18 (64.3%)	3 (0.69-14.86)	0.243
On medication	2 (16.7%)	9 (56.2%)	11 (39.3%)	6.43 (1.05-39.33)	0.044*
Number of seizure[a] (10:11)					0.395
1	4 (40.0%)	7 (63.6%)	11 (52.4%)	1	
> 1	6 (60.0%)	4 (36.4%)	10 (47.6%)	0.38 (0.07-2.22)	
Type of seizure[a] (12:15)					0.795
Partial seizure	5 (41.7%)	7 (46.7%)	12 (44.4%)	1	
Generalized seizure	7 (58.3%)	8 (53.3%)	15 (55.6%)	0.82 (0.18-3.78)	
Abnormal neuro exam[a] (12:11)	1 (8.3%)	6 (54.5%)	7 (30.4%)	13.20 (1.24-140.68)	0.027*
Abnormal brain imaging[a] (8:15)	5 (62.5%)	11 (73.3%)	16 (69.6%)	1.65 (0.26-10.31)	0.657
On antiepileptics	4 (33.3%)	11 (68.8%)	15 (53.6%)	4.40 (0.89-21.78)	0.063
EEG after seizure onset (days) [a] (9:16)	10 (1-120)	12 (4-120)	12 (1-120)		0.798
≥ 10 days	5 (55.6%)	10 (62.5%)		1.33 (0.25-7.01)	1.000
Recurrent seizure[a] (9:12)	3 (33.3%)	2 (16.7%)	5 (23.8%)	0.40 (0.05-3.13)	0.611

Values are represented as n (%), Mean ± SD, Median (Min-Max), *p < 0.05, [a] value in subgroup is not equal to total number according to missing data

Discussion

Abnormal EEG in first unprovoked seizure in the present study was 57.41%. This was similar to abnormal EEG found in adults presenting with first unprovoked seizure in previous studies, which ranged from 12-73% (average yield 51%)[5]. EEG abnormalities were found in 46.7% of patients with partial seizure and 53.3% of patients with generalized seizure. These findings were different from those of another study in children with first unprovoked seizure, in which abnormal EEG was more common in partial seizure than in generalized seizure[6]. The authors was unable to find any study in adult populations to compare with the present findings. The only EEG finding that has a strong correlation with epilepsy is epileptiform activity and epileptiform discharge was found in 28.6% of the patients in the present study. This is comparable with the data from other studies, in which routine EEG revealed epileptiform abnormalities in approximately 23% of patients[5]. Focal or generalized slow waves are not specific for diagnosis of epilepsy, and can be found in patients with epilepsy, encephalitis, brain tumor, metabolic encephalopathies and other diseases that affect brain function. Beta activities were found in patients who received sedative drugs. When comparing the characteristics of the patients who had abnormal EEG with those who had normal EEG, the author found that the patients who were taking medication for their underlying diseases and who had abnormal neurological examinations had a higher risk of abnormal EEG. The patients who were taking medication might already have had brain pathology or other risk factors for development of new brain lesions, or drug side-effects could have been the cause of abnormal EEG. The abnormalities on neurological examination might have been caused by the fact that their lesions were at the cortex or that the lesions were large, thereby enabling the EEG to detect the abnormalities. Patients with underlying diseases, or who had received antiepileptic drugs for the event, were more likely to have abnormal EEG. These findings reflected the fact that the patients with abnormal EEG had underlying diseases and received more antiepileptic drugs when they had seizure attacks. However, these findings were not statistically significant, perhaps because of the small number of patients. The limitations of the present study were as follows: firstly, it was a retrospective study in which some data was missing; secondly, the sample size was

small, although the recruitment period was more than 4 years; thirdly, most EEG was done later than 24 hours after the seizure, which detects less epileptiform abnormality than EEG done within 24 hours[7]. Moreover, if EEG with sleep deprivation is done, it will reveal more abnormalities than the standard EEG[8]. However, this study represented routine clinical practice in first unprovoked seizure and could be used as basic information for improvement of services in the Neurology unit in Rajavithi Hospital and for planning future research.

Conclusion

EEG abnormalities were detected in more than half of the patients with first unprovoked seizure, which is comparable to previous studies. Abnormal EEG findings were more common in patients who were taking medication and who had abnormal neurological examinations. EEG should be considered for all patients with first unprovoked seizure.

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Potential conflicts of interest

None.

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ความผิดปกติของคลื่นสมองในผู้ป่วยที่มีอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้นในโรงพยาบาลราชวิถี

เพชรรัตน์ ดุสิตานนท์

***ภูมิหลัง**: คลื่นสมองมีบทบาทสำคัญในการวินิจฉัยโรคลมชัก การแบ่งกลุ่มอาการของโรคลมชักการบอกตำแหน่งรอยโรค และการพยากรณ์การเกิดอาการชักซ้ำ แต่ยังไม่มีการศึกษาเกี่ยวกับคลื่นสมองในผู้ป่วยที่มีอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้นในโรงพยาบาลราชวิถี*

***วัตถุประสงค์**: การศึกษานี้มีจุดมุ่งหมายเพื่อหาความชุกของความผิดปกติของคลื่นสมองในผู้ป่วยที่มีอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้นและความชุกของความผิดปกติของคลื่นสมองในผู้ป่วยที่มีอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้นแบบ partial และ generalized*

***วัสดุและวิธีการ**: การศึกษานี้เป็นการศึกษาแบบ retrospective study ในผู้ป่วยผู้ใหญ่ 28 ราย ที่มาด้วยอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้น ได้ทำการตรวจคลื่นสมองในผู้ป่วยทุกรายและข้อมูลพื้นฐานได้ถูกบันทึกไว้*

***ผลการศึกษา**: จากผู้ป่วย 28 ราย ที่มาด้วยอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้น ตรวจพบคลื่นสมองผิดปกติ 16 ราย (57.4%) (95%CI) ของความผิดปกติของคลื่นสมองคือ 37.6-76.7% ความผิดปกติของคลื่นสมองพบในผู้ป่วย 7 ราย (46.7%) ที่มีอาการชักแบบ partial และ 8 ราย (53.3%) ในผู้ป่วยที่มีอาการชักแบบ generalized ผู้ป่วย 8 ราย (28.6%) ตรวจพบ epileptiform discharges ผู้ป่วยที่รับประทานยาเพื่อใช้รักษาโรคประจำตัวและผู้ป่วยที่ตรวจพบความผิดปกติจากการตรวจร่างกายทางระบบประสาท จะสัมพันธ์กับความเสี่ยงที่เพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติในการตรวจพบความผิดปกติของคลื่นสมอง (OR 6.43, 95%CI 1.05-39.33, p = 0.044 และ OR 13.2, 95%CI 1.24-140.68, p = 0.027 ตามลำดับ)*

***สรุป**: ตรวจพบความผิดปกติของคลื่นสมองในผู้ป่วยที่มีอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้นในผู้ป่วยมากกว่าครึ่งซึ่งใกล้เคียงกับการศึกษาต่างๆที่ผ่านมา ควรพิจารณาให้การตรวจคลื่นสมองในผู้ป่วยทุกรายที่มาด้วยอาการชักครั้งแรกโดยไม่มีสิ่งกระตุ้น*