DOI: 10.4149/BLL_2014_035

Bratisl Lek Listy 2014; 115 (3)
168 – 170

CLINICAL STUDY

The importance of interictal electroencephalography in paroxysmal states

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Abstract: *Introduction:* Electroencephalography (EEG) is a non-invasive investigation method playing an important role in differential diagnostics of seizures. In this article authors point out to its importance, but also limitations.
Material and methods: Native interictal EEG findings were evaluated in inpatients after solitary unprovoked epileptic seizures (n=84), patients with sporadic epileptic seizures (n=179), patients with "chronic" epilepsy (n=324), outpatients with epilepsy (n=300), patients with syncope (n=100), patients with neurocardiogenic syncope (n=70), patients with migraine (n=100) and patients with tetanic syndrome (n=100). EEG findings were evaluated as normal or abnormal and abnormal findings were further divided into epileptic and non-epileptic, focal and generalized.
Results: In native EEG, epileptic manifestations were registered in 14.29 % of patients after solitary unprovoked epileptic seizures, in 25.7 % of patients with sporadic epileptic seizures, in 37.34 % of patients with chronic epilepsy and in 32 % of outpatients with epilepsy. Interictal EEG abnormalities (epileptiform and non-epileptiform) in non-epileptic diagnoses were at least registered in patients with syncope, but also in this group abnormal findings occurred in 30 % of them. We registered epileptiform abnormalities in 5 % of patients with migraine, in 4 % of patients with tetanic syndrome and in 2 % of patients with syncope.
Conclusion: The diagnosis of epilepsy and non-epileptic seizures is a only a clinical diagnosis. EEG is a very important investigational method in this group of patients, but still only additional *(Tab. 4, Fig. 2, Ref. 14)*. Text in PDF *www.elis.sk.*
Key words: electroencephalography, epileptic seizures, non-epileptic seizures.

Electroencephalography (EEG) is a non-invasive neurophysiologic investigation method which plays an important role in differential diagnostics of seizures. It has the biggest benefit in diagnostics of epilepsy. The correlation of the history, clinical manifestation and registration of the specific epileptiform EEG graphoelements can support the diagnosis of epilepsy (1). But on the other hand we should not overvalue the importance of this examination. Literature sources provide us with a well-known fact, that approximatelly 3 % of healthy indviduals without subjective complaints who underwent EEG have abnormal findings. Occurrence of spikes and sharp waves – the typical epileptiform graphoelements- can be registered in 1–2 % of healthy adult individuals and also in a slightly higher number in healthy children (2). During a common EEG examination with the use of hyperventilation and photostimulation, when the time of registration is about 15 minutes, there is a low chance of recording specific epileptiform graphoelements in some cases (if there are no permanent subclinical interictal epileptiform graphoelements). It is necessary to realise that abnormal EEG findings can be found also in other types of seizures. Several authors point out to a frequent presence of interictal EEG abnormalities in patients with migraine (3, 4, 5). Presence of EEG abnormalities as well as their sensitivity to hyperventilation is well-known in patients with tetanic syndrome (6). Abnormalities in interictal EEG find-

Tab. 1. Interictal EEG findings of our inpatients after a solitary unprovoked epileptic seizure, patients with sporadic epileptic seizures and patients with chronic epilepsy.

EEG findings	Solitary unprovoked epileptic seizures (n=84)	Sporadic epileptic seizures (n=179)	Chronic epilepsy (n=324)
Normal	41 (48.81%)	77 (43.02%)	89 27.47%)
Non-epileptiform abnormality	31 (36.90%)	56 (31.28%)	114 (35.19%)
Epileptiform abnormality	12 (14.29%)	46 (25.70%)	121 37.34%)

Tab. 2. Interictal EEG findings in group of outpatients with partial epileptic seizures and generalized epileptic seizures.

	Normal	NFA	NNA	EFA	ENA
Partial epileptic seizures (n=150)	39 (26%)	30 (20%)	29 (19.33%)	35 (23.33%)	17 (11.33%)
Generalized epileptic seizures(n=150)	50 (33.33%)	18 (12%)	38 (25.33%)	20 (13.34%)	24 (16%)
Epilepsy-overall (n=300)	89 (29.67%)	48 (16%)	67 (22.33%)	55 (18.33%)	41 (13.67%)

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Tab. 3. Interictal EEG findings of our patients with migraine, tetanic syndrome, syncope, neurocardiogenic syncope.

	Normal	NFA	NNA	EFA	ENA
Migraine (n=100)	53 (53%)	4 (4%)	38 (38%)	3 (3%)	2 (2%)
Tetanic syndrome (n=100)	35 (35%)	10 (10%)	51 (51%)	1 (1%)	3 (3%)
Syncope (n=100)	70 (70%)	12 (12%)	16 (16%)	1 (1%)	1 (1%)
Neurocardiogenic syncope (n=50)	27 (54%)	9 (18%)	14 (28%)	0 (0%)	0 (0%)

Tab. 4. Interictal EEG findings in epilepsy, migraine, tetanic syndrome, syncope and neurocardiogenic syncope in a group of our outpatients.

EEG findings	Epilepsy (n=300)	Migraine (n=100)	Tetanic syndrome (n=100)	Syncope (n=100)	Neurocardiogenic syncope (n=50)
Normal	89 (29.67%)	53 (53%)	45 (45%)	70 (70%)	27 (54%)
Nonepileptiform abnormality	115 (38.33%)	42 (42%)	61 (61%)	28 (28%)	23 (46%)
Epileptiform abnormality	96 (32%)	5 (5%)	4 (4%)	2 (2%)	0 (0%)

ings in other seizures can certainly complicate the diagnosis. We have to pinpoint the fact that absence of epileptic graphoelements doesn't always mean that a patient can't have epilepsy, and also their registration can explain a possibility of coexistence of short loss of consciousness or seizures of another genesis. The aim of this article is to point out the importance of native interictal EEG examination in the diagnostics of seizures, but also to pay attention to its limitations.

Material and methods

We evaluated a native interictal EEG findings in patients:

- after solitary unprovoked epileptic seizures (n=84)
- with sporadic epileptic seizures (n=179)
- with chronic epilepsy (n=324)

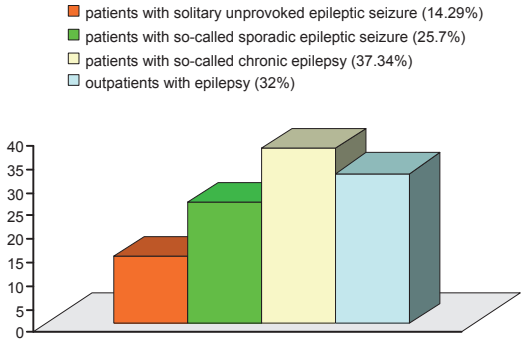

Fig. 1. Incidence of epileptiform EEG graphoelements in the native interictal EEG recording of patients after a solitary epileptic seizure and with the diagnosis of epilepsy.

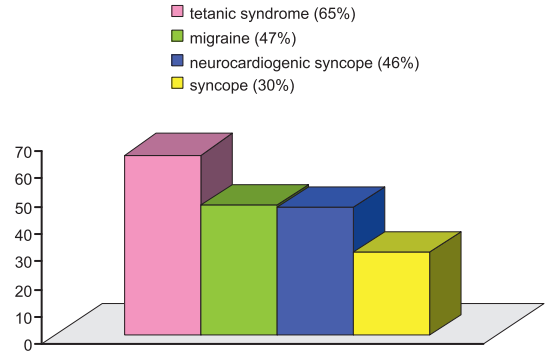

Fig. 2. Comparison of incidence of EEG abnormalities in a selected group of nonepileptiform seizures. EEG – electroencephalography, NFA – non-epileptiform regional (focal) abnormality, NNA – non-epileptiform generalized(nonfocal) abnormality, EFA – epileptiform regional abnormality, ENA – epileptiform generalized abnormality.

- outpatients with a presence of partial seizures (n=150) and generalized seizures (n=150)
- with migraine (n=100)
- with tetanic syndrome (n=100)
- with syncope (n=100) and neurocardiogenic syncope verified by HUT-test (n=50).

Patients who overcame maximum of 5 seizures in one year's time have been defined as patients with sporadic epileptic seizures. Patients who overcame at least five seizures in a year have been defined as patients with chronic epilepsy. We analysed the native interictal EEG examination taken from the hairy surface of the scalp with a connection of electrodes in 10–20 systems, the time of recording was 20 minutes, in every case we carried out 4-minute oral hyperventilation in a frequency of 30 breaths per minute and photostimulation with flashes of a neon lamp- flashes frequency of 4, 8, 10, 12, 14, 24 Hz was used. The findings were evaluated as normal and abnormal and abnormal findings were further divided into epileptiform and non-epileptiform. We considered as a specific epileptiform activity the presence of spikes, sharp waves, complexes of a spike and sharp wave, complexes of more spikes and a sharp wave and complexes of a sharp and slow wave. We considered other EEG abnormalities as non-epileptiform (non-specific). EEG abnormalities /epileptiform and non-epileptiform/ were further divided into focal and generalized.

Results

In native EEG, epileptic manifestations were registered in 14.29 % of patients after solitary unprovoked epileptic seizures, in 25.7 % of patients with sporadic epileptic seizures, in 37.34 % of patients with chronic epilepsy and in 32 % of outpatients with epilepsy. Interictal EEG abnormalities (epileptiform and non-epileptiform) in non-epileptic seizure states were the least registered in patients with syncope, but also in this group abnormal findings occured in 30 % of them. We registered epileptiform abnormalities in 5 % of patients with migraine, in 4 % of patients with tetanic syndrome and in 2 % of patients with syncope.

Discussion

We found out, that the incidence of epileptiform manifestation in the native EEG of patients after a solitary unprovoked epileptic seizure (14.29 %) is lower than other authors mention, slightly lower compared to the literature in a group of patients with sporadic epileptic seizures (25.7 %) (1, 7, 8). Bartko et al (1984) recorded comparatively low incidence of epileptiform graphoelements in interictal EEG (9). An explanation may be the well-known fact of transient incidence of abnormalities in EEG recordings. And so we consider this transient incidence of epileptiform EEG abnormalities in patients with epilepsy as a factor participating in different results of individual studies. In patients with chronic epilepsy and in our outpatients with epilepsy we recorded an epileptiform activity in native EEG in 37.34 %/ 32 %, which is approximately in accordance with other authors (7). It seems logical that the incidence of epileptiform EEG manifestations depends on the number of overcome epileptic seizures (the lowest in the group of patients after solitary epileptic seizures and the highest in the group of patients with chronic epilepsy). High percentage of non-specific (non-epileptic) abnormal EEG recording in our group of patients after solitary epileptic seizure and with "chronic" epilepsy is in accordance with the literature data. But it is very important to realize the limitations of the EEG manifestation. First of all we have to repeat that a normal EEG finding doesn't exclude the clinical diagnosis of epilepsy and vice versa, the presence of epileptiform EEG abnormality doesn't prove that a patient has got epilepsy. There is also a well-known fact of frequent incidence of abnormal interictal EEG findings in a group of non-epileptic seizures (10, 11). We also confirmed these findings, in the group of patients with a tetanic syndrome, we recorded an abnormal native interictal EEG finding in 65 % of cases. From non-epileptic diagnoses (tetanic syndrome, migraine, syncope, neurocardiogenic syncope) we found out the least number of interictal EEG abnormalities in patients with syncope, but also in this group of patients abnormal interictal EEG findings occured in 30 %. We observed epileptiform abnormalities in 5 % of patients with migraine, in 4 % of patients with tetanic syndrome and in 2 % of patients with syncope. These numbers have to be taken into consideration in the interpretation of EEG findings. In terms of diagnostics and relevance of EEG, the evaluation of EEG recording is also important. In spite of the fact that the evaluation criteria are arbitrarily standardized and accepted, the EEG evaluation is always subjectively affected by the investigator himself. Practical experience indicates that a large number of under-knowledgeable EEG descriptions still exist (12, 13). Our team has got very good long-term experience with evaluation of controversial EEG findings by more investigators (electroencephalographists). Participation of more investigators in the evaluation of controversial cases, in our opinion, significantly reduces the risk of incorrect assessment of an EEG recording and secondarily also reduces an incorrect clinical diagnosis (14).

Conclusion

The diagnosis of a solitary epileptic seizure, epilepsy and non-epileptic seizures is a clinical diagnosis. This article refers to a fact that EEG is a very important investigation method in a group of these patients, but still only additional.

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Received April 20, 2012.
Accepted October 27, 2013.