

## COMPARATIVE ANALYSIS OF NEUROPHYSIOLOGICAL FEATURES IN YOUNG WOMEN AND MEN SUFFERING FROM EPILEPSY

A. O. VOITIUK<sup>1,2</sup>, T. A. LITOVCHENKO<sup>1</sup>

<sup>1</sup> *Kharkiv Medical Academy of Postgraduate Education,*

<sup>2</sup> *Medical Centre «Neiron», Kharkiv, Ukraine*

**The problem of epilepsy in young men and women has been considered. An electroencephalographic examination was carried out for each patient, on the basis of which a comparative analysis of electroencephalogram depending on gender was performed.**

*Key words: epilepsy, electroencephalogram, comparative analysis, young men and women.*

Epilepsy is a polyetiological disease caused by brain damage and characterized with repeated seizures, impaired sensory, autonomic, cognitive functions, resulting from excessive neuronal discharges in cerebral cortex as well as it is often accompanied with personality changes [1].

The repeated seizures are the result of excessive electrical discharges in a group of brain cells. Such discharges can occur in various parts of brain [2]. For example, epileptic discharges arising from the temporal cortex affect the level of male sex hormones, that was confirmed by their normalization after removing a lesion in the temporal region [3].

The definition of epilepsy through the concept of the discharge of neurons determines the most crucial importance of electroencephalography (EEG) in epileptology [4].

Epilepsy presents a certain problem for each sex, that requires gender-specific approaches when managing and treating such patients [5, 6]. However, with such a great scientific interest, most of the reports have been devoted to certain issues of epilepsy in men and those in women, few scientific studies comparatively analyze the characteristics of epilepsy both in men and women.

The purpose of this study was to comparatively analyze the EEG changes in young women and men suffering from epilepsy.

This study involved 60 people (30 men and 30 women, age-comparable) aged 18–44 years with a reliable diagnosis of epilepsy [2]. According to the WHO classification, all subjects were referred to the group of young people. The mean age of the patients was  $31.7 \pm 3.12$ .

A comprehensive clinical, neurological and neurophysiological study of the patients with a reliable diagnosis of epilepsy was carried out, the data from the histories of the disease and life were taken into account.

The investigation did not involve the patients with strong somatic pathology, acute and chronic ones, as well as with brain tumors, acute craniocerebral trauma and acute infectious diseases of various etiologies. In addition, the study excluded the individuals with a single unprovoked epileptic seizure,

patients having only febrile seizures or neonatal convulsions, those with acute symptomatic seizures (associated with acute systemic disease, intoxication or acute stage of cerebral damage), individuals with severe neurological deficits (afatic and motor disorders), persons with severe comorbid pathology, the ones after surgical interventions and at terminal stage of any disease.

The patients with epilepsy were traditionally examined. The family history, that of the disease with a retrospective analysis of the age of the first seizure occurrence, provoking factors, therapy effectiveness and tolerability, as well as transformation of seizures in the patients with a long history were carefully studied. The neurological status of each patient was assessed according to the generally accepted method, using an electrophysiological investigation (routine EEG) [7].

EEG was performed according to the traditional technique using 16-channel electroencephalographic diagnostic complexes DX-4000, DX-6000 and «ExpertTM» («TREDEX», Ukraine). The internationally recognized scheme of electrodes «10–20» placement was used in this study. Examination was conducted in a room isolated from noise after dark adaptation within the interictal period. The registration was performed for 20–25 minutes (quality recording). The standard study procedure consisted of recording a «background EEG» using functional samples: recording with eyes open, hyperventilation, photostimulation of 2 Hz and 10 Hz.

According to the International Classification of Epilepsy and Epileptic Seizures (ILAE, 2017), all men were divided according to the epilepsy types (Figure 1) [8].

From the data presented above, the domination of young men with combined focal and generalized epilepsy can be found.

According to etiology, in the patients examined the structural epilepsy (18 people, 60%) prevailed, also there were found infectious epilepsy (9 patients, 30%) and epilepsy of unknown etiology (3 patients, 10%). The duration of the disease ( $M \pm SD$ ) was in average  $12.6 \pm 4.3$  years.

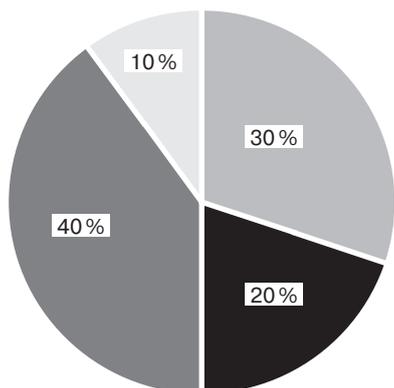


Figure 1. Number of male patients depending on epilepsy type:  – focal epilepsy;  – generalized epilepsy;  – combined (focal and generalized) epilepsy;  – unknown epilepsy

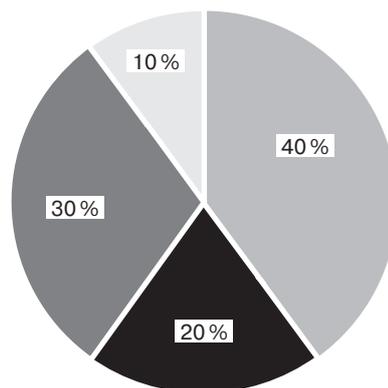


Figure 2. Number of female patients depending on epilepsy type:  – focal epilepsy;  – generalized epilepsy;  – combined (focal and generalized) epilepsy;  – unknown epilepsy

Similarly, all women were also divided according to the epilepsy type (Figure 2).

The focal epilepsy prevailed mainly in young women. According to the etiology of the examined patients, the infectious epilepsy prevailed in 12 people (40%), and the metabolic epilepsy was observed in 6 patients (20%), the structural one was found in 7 patients (30%) and the unknown etiology epilepsy was revealed in 3 patients (10%). The catamenal epilepsy in women was detected in 6% of patients. The disease duration ( $M \pm SD$ ) averaged  $15.3 \pm 3.4$  years.

When analyzing the etiological aspects of the epilepsy formation, depending on gender characteristics, it was found that among men, the most common cause of epileptic seizures was traumatic brain injury (TBI) (43.4% of cases against 27.8% in women), that indicated an important role of injuries in the epileptogenesis development in men. While in women, among the causes of epilepsy the infectious-allergic brain diseases prevailed (12 cases).

EEG results in persons with epilepsy of both sexes demonstrated a decrease in the amplitude of  $\alpha$ -rhythm ( $24.2 \pm 6.0 \mu V$  in men compared with  $21.1 \pm 4.3 \mu V$  in women), but no significant slowdown in this rhythm was found. The overall  $\alpha$ -rhythm index was significantly reduced: in average it made  $36.48 \pm 1.79\%$  in male patients and  $33.67 \pm 2.03\%$  in female patients. The revealed disorganization, smoothed or atypical zonal distribution of the  $\alpha$ -rhythm indicate the lack of activating influences. The dominance of  $\beta_1$ -rhythm over the entire convexital surface was also revealed in 11 women (36.7%) and 17 men (56.7%). The  $\beta_1$ -rhythm index was increased and averaged  $35.24 \pm 2.71\%$  in men as well as  $34.78 \pm 1.96\%$  in women. Most of the patients had a high-amplitude ( $> 20 \mu V$ ) and low-frequency  $\beta_1$ -rhythm (in average  $6.78 \pm 0.9$  Hz in women and  $7.12 \pm 0.9$  Hz in men). The low-frequency high-amplitude slow wave activity was regarded as an EEG reflection of degenerative and dystrophic processes in brain. The diffuse sharp waves were detected in the patients with epilepsy, and focal activity as local paroxysms of  $\theta$ -waves was

also observed. The general index of  $\theta$ -rhythm was  $19.23 \pm 1.29\%$  in young women and  $21.3 \pm 2.06\%$  in young men with epilepsy. The photostimulation caused paroxysms of bilaterally synchronous acute and slow waves, «acute-slow» wave complexes. The hyperventilation led to increased amplitude of the  $\theta$ -rhythm ( $18.8 \pm 0.94 \mu V$  and  $21 \pm 0.86 \mu V$  in women and men, respectively), appearance of  $\delta$ -waves, a greater severity of true epileptiform phenomena: spikes, «acute wave-slow wave» complexes, «spike-slow wave» complexes, etc. (Figure 3) [9].

The presented EEG fragment of patient T., 18 y. o., is recorded mild diffuse disorders of the bioelectrical activity of the brain without local pathology. The alpha rhythm with a frequency of 8–14 Hz is recorded above both hemispheres. Interhemispheric asymmetry of the alpha rhythm is 3%. The dominant frequency of the alpha rhythm is 8.0 Hz. The alpha rhythm is predominant in O2-A1. The modulation of the alpha rhythm is moderate. The high-frequency beta rhythm with a frequency of 20–35 Hz is recorded. The high-frequency beta rhythm index over the left hemisphere is 1%. The high-frequency beta rhythm index over the right hemisphere is 1%. The high-pitched beta rhythm is predominant in O2-A1. There is a delta rhythm with a frequency of 1–4 Hz. The dominant frequency of the delta rhythm is 1.3 Hz. The delta rhythm prevails in O2-A1. There is a theta rhythm with a frequency of 4–8 Hz. The dominant frequency of theta rhythm is 4.0 Hz. The theta rhythm index is 11%. The theta rhythm is predominant in O2-A1. The epileptiform activity is recorded in the form of «acute wave – slow wave» complexes in the right occipital region with a tendency to generalization, less pronounced in the left occipital region.

The focal seizures had EEG expression as unilateral or bilateral generalized asynchronous foci, more often in the temporal or frontal regions in both men and women. The «spike – slow wave» or «acute wave – slow wave» complexes with a focal onset and gradual generalization were observed among the

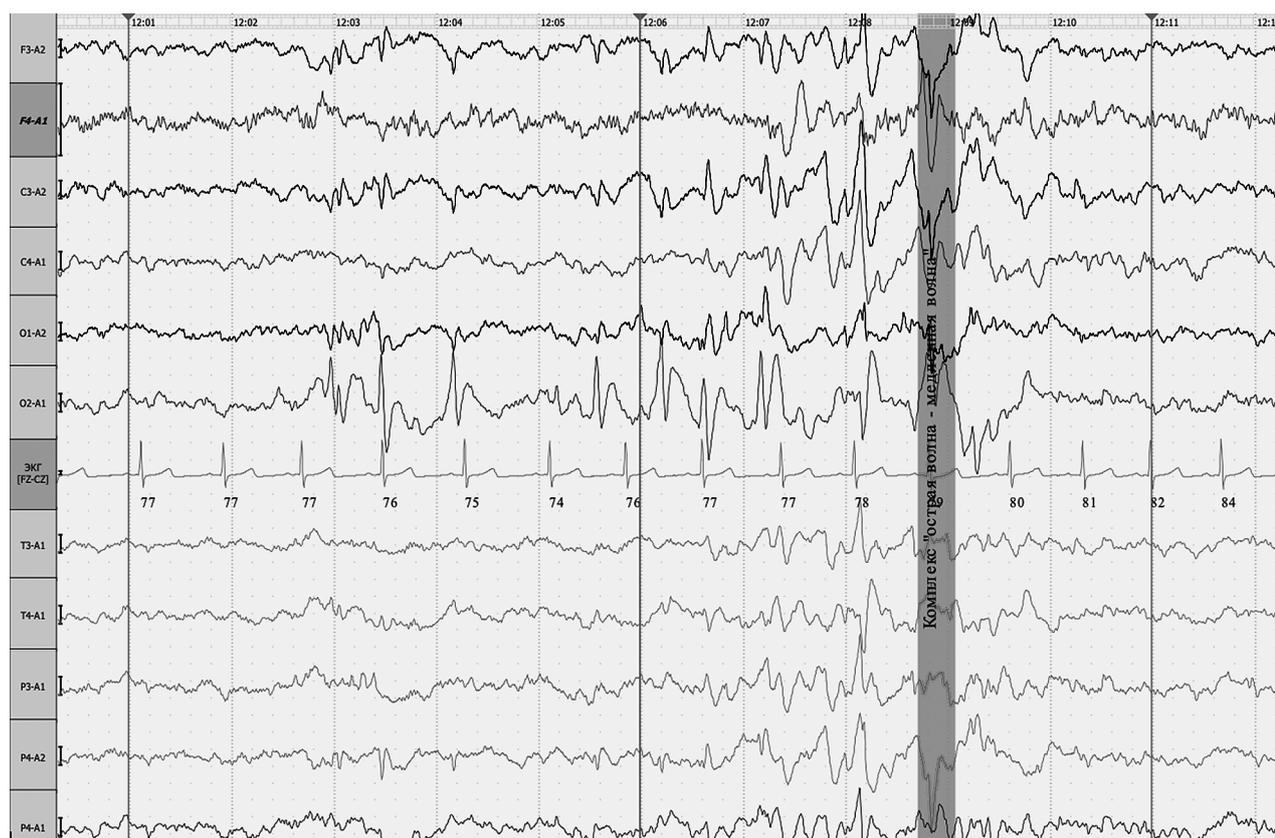


Figure 3. Electroencephalogram of patient T., 18 y. o.

pathological patterns in EEG in the patients with generalized seizures.

Epilepsy is a certain problem for each gender. The diagnosis of this pathology is largely determined by the results of an EEG study [10, 15]. There are very few scientific studies devoted to a comparative analysis of the characteristics of epilepsy in men and women at the moment. The alpha rhythm was significantly more common in men than in women. The epileptiform disorders were recorded in interictal EEG, but without a distinct hemispheric predominance in the overwhelming number of patients.

After performing this analysis and comparing the results obtained with previous studies [11–14], we draw the same conclusion that the changes in bioelectric activity in epilepsy occur according to the general mechanisms of epileptogenesis regardless of gender.

Thus, there were no differences in bioelectric activity between the male and female groups, but the indices tended not to reach the statistical significance in men (Table).

However, the EEG was more often determined the involvement of stem structures, diffuse pathological fluctuations, which was regarded as electrophysiological manifestations of degenerative and dystrophic processes in the brain in men with a TBI history. Despite the fact that men and women had significant differences in the epilepsy etiology ( $p < 0.05$ ), there was no significant difference between the groups of men and women during EEG. This suggests that changes in bioelectrical activity in epilepsy occur according to the general mechanisms of epileptogenesis, regardless of gender [10].

#### Indices of bioelectric activity

Index	1 group (men)	2 group (women)
$\alpha$ -rhythm's amplitude, $\mu V$ *	24.2 $\pm$ 6.0	21.1 $\pm$ 4.3
$\alpha$ -rhythm's index, %*	36.48 $\pm$ 1.79	33.67 $\pm$ 2.03
$\beta_1$ -rhythm's index, %*	35.24 $\pm$ 2.71	34.78 $\pm$ 1.96
$\beta_1$ -rhythm's frequency, Hz*	7.12 $\pm$ 0.9	6.78 $\pm$ 0.9
$\theta$ -rhythm's amplitude, $\mu V$ *	21 $\pm$ 0.86	18.8 $\pm$ 0.94
$\theta$ -rhythm's index, %*	21.38 $\pm$ 2.06	19.23 $\pm$ 1.29

\*  $p < 0.05$ .

## References

1. *Мухин К. Ю.* Определение и классификация эпилепсий. Проект классификаций эпилептических приступов 2016 года // Русский журн. детской неврологии. 2017. № 1. С. 8–20.
2. *Brunier A., Lindmeier Ch.* WHO highlights scarcity of treatment for epilepsy in low-income countries. 2019. URL: <https://www.who.int>
3. *George L.* Human sexuality, sex hormones and epilepsy // *Epilepsy and behavior*. 2015. Vol. 7, № 2. P. 22–28.
4. *Зенков Л. П.* Клиническая электроэнцефалография (с элементами эпилептологии). М.: МЕДпресс-информ, 2017. 356 с.
5. *Crawford P., Duncan S.* Gender issues // *Handb. Clin. Neurology*. 2012. Vol. 108. P. 759–781.
6. *Rektor I., Kuba R., Brázdil M.* Interictal and Ictal EEG Activity in the Basal Ganglia: An SEEG Study in Patients with Temporal Lobe Epilepsy // *Epilepsia*. 2012. Vol. 43. P. 253–262. <https://doi.org/10.1046/j.1528-1157.2002.28001.x>
7. A practical clinical definition of epilepsy / R. S. Fisher et al. // *Epilepsia*. 2014. Vol. 44 (4). P. 475–482.
8. *Hauser W. A.* Incidence and prevalence // *Epilepsy: A comprehensive textbook*. Philadelphia: Lippincott-Raven Publishers, 2007.
9. Medial temporal lobe epilepsy: gender differences / J. Janszky et al. // *J. of Neurology, Neurosurgery & Psychiatry*. 2016. Vol. 75 (5). P. 773–775. <https://doi.org/10.1136/jnnp.2003.020941>
10. *Panayiotopoulos C.* A clinical guide to epileptic syndromes and their treatment. (2nd ed.). Springer, 2007.
11. Clinical utility of EEG in diagnosing and monitoring epilepsy in adults / W. O. Tatum et al. // *Clin. Neurophysiology*. 2018. Vol. 129. P. 1056–1082.
12. The definition and classification of the epilepsy / R. S. Fisher et al. 2014. URL: <http://www.ilae.org>
13. What do you need to know about epilepsy and how to provide first aid. URL: <http://www.moz.gov.ua>
14. EEG in epilepsy // W. O. Tatum, N. N. Desai, J. Siegel, J. M. Stern. 2019. URL: [http://www.medlink.com/article/eeg\\_in\\_epilepsy](http://www.medlink.com/article/eeg_in_epilepsy)
15. *Kramarenko A. V.* Electroencephalogram. Analysis from the point of view of information theory. 2002. URL: <http://www.tredex-company.com>

### ПОРІВНЯЛЬНИЙ АНАЛІЗ НЕЙРОФІЗІОЛОГІЧНИХ ОСОБЛИВОСТЕЙ ЖІНОК І ЧОЛОВІКІВ МОЛОДОГО ВІКУ, ЯКІ СТРАЖДАЮТЬ НА ЕПІЛЕПСІЮ

А. О. ВОЙТЮК, Т. А. ЛИТОВЧЕНКО

Розглянуто проблему епілепсії у чоловіків і жінок молодого віку. Всім пацієнтам проведено електроенцефалографічне обстеження, за результатами якого зроблено порівняльний аналіз електроенцефалограми залежно від статі.

*Ключові слова:* епілепсія, електроенцефалограма, порівняльний аналіз, чоловіки і жінки молодого віку.

### СРАВНИТЕЛЬНЫЙ АНАЛИЗ НЕЙРОФИЗИОЛОГИЧЕСКИХ ОСОБЕННОСТЕЙ ЖЕНЩИН И МУЖЧИН МОЛОДОГО ВОЗРАСТА, СТРАДАЮЩИХ ЭПИЛЕПСИЕЙ

А. А. ВОЙТЮК, Т. А. ЛИТОВЧЕНКО

Рассмотрена проблема эпилепсии у мужчин и женщин молодого возраста. Всем пациентам проведено электроэнцефалографическое обследование, по результатам которого сделан сравнительный анализ электроэнцефалограммы в зависимости от пола.

*Ключевые слова:* эпилепсия, электроэнцефалограмма, сравнительный анализ, мужчины и женщины молодого возраста.

Accepted in 29.10.2020