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FEATURES OF THE BIOELECTRICAL ACTIVITY OF THE BRAIN AND CEREBRAL HEMODYNAMICS IN PATIENTS WITH HYPERTENSIVE DYSCIRCULATORY ENCEPHALOPATHY AND HYPOTHYROIDISM

Olga Ye. Kovalenko^{1,2}, Olena V. Litvin¹

¹ State Institution of Science «Research and Practical Centre of Preventive and Clinical Medicine» State Administration Department, Kyiv, Ukraine

² Shupyk National Healthcare University of Ukraine, Kyiv, Ukraine

Summary

Encephalopathy is common in people of working age. In the last decade there was an important question the relationship of thyroid and cerebrovascular disease. The aim of the study was to investigate the characteristics of the brain's elektrogenesis and cerebral hemodynamics in patients with hypertensive encephalopathy and related dyscirculatory hypothyroidism.

We examined 97 patients, including 60 people with the HDE and the associated hypothyroidism and 37 – with the HDE without hypothyroidism.

The fact, that bioelectrical activity of the brain in patients with hypothyroidism and related HDE was mostly characterized by desynchronization and disorganization of the cortical rhythm, was revealed during the study. Changes revealed by the EEG reflected the presence of metabolic and hemodynamic disturbances of the brain. Also, in patients with GDE and accompanying hypothyroidism, according to the duplex scanning of cerebral vessels, there is a significant decrease in cerebral blood supply and structural changes in vessels with a decrease in the elasticity of the common carotid artery and vertebral arteries and a decrease in cerebral reactivity accordingly.

Thus, the comorbidity of HDE and hypothyroidism appears credible changes in the functional activity of the brain and decrease in cerebral reactivity.

Key words: hypertensive dyscirculatory encephalopathy, hypothyroidism, electroencephalography, duplex scanning of vessels, cerebral reactivity.

INTRODUCTION

Over the last 10 years the growth rate of cerebrovascular diseases (CVD) has doubled. The largest share in the structure of CVD is occupied by a chronic cerebrovascular accident as dyscirculatory encephalopathy (DE), which is most common in people of working age [1,2].

The main risk factors for cerebrovascular pathology are arterial hypertension, atherosclerosis of cerebral vessels, diabetes mellitus, coronary heart disease, and thyroid lesions [3].

In the practice of a neurologist at a polyclinic there are often happenings, when patients with dyscirculatory encephalopathy have a decrease in the functional activity of the thyroid gland. In the last decade an important issue

of the relationship between thyroid and cerebrovascular pathology has arisen.

Hypothyroidism is a condition that is associated with a lack of thyroid hormones in organs and tissues, which leads to a violation of organs and systems including the central nervous system. The number of cases of hypothyroidism in the population according to the literature is from 3 to 8%, and in recent years there has been an increase in pathology in young and middle-aged people [4,5,6,7].

The goal of our study was to study the features of brain electrogenesis and hemodynamics of the main vessels of the head and the neck in patients with hypertensive dyscirculatory encephalopathy (HDE) and concomitant hypothyroidism.

MATERIALS AND METHODS

There was a clinical and neurological examination of 97 patients with hypertensive dyscirculatory encephalopathy, of which 60 patients had concomitant pathology in the form of hypothyroidism. Among the examined patients were 88 (90.7%) women, and 9 (9.3%) men.

All patients with GDE were divided into two groups, which were statistically comparable in terms of the main diseases (hypertensive dyscirculatory encephalopathy), sex and age. The first group (main) included patients (60 people), who had concomitant hypothyroidism in addition to GDE. The second group (control) consisted of 37 people without hypothyroidism. Among the examined patients of the main group there were 57 (95%) women, and 3 (5%) men. Among patients in the control group, there were 31 (83.8%) women, and 6 (16.2%) men. The age of the patients ranged from 40 to 66 years old (average age 58.2 ± 0.91 years old).

The degrees of dyscirculatory encephalopathy were established according to generally accepted criteria for the diagnosis of the specified pathology [11, 12, 13]. The distribution of groups according to neurological pathology (GDE) was statistically homogeneous in both clinical groups. On the other hand the stages of hypertensive disease, which pathogenetically related to cerebral disorders, differed: in the group with hypothyroidism with a more severe form of brain pathology (DE-II) observed GC I in 30.0% of patients, at the same time a similar situation occurred only in 13.5% of patients without hypothyroidism. That fact indirectly indicates the presence of additional reasons, which deepen the cerebral deficit – probably hypothyroidism. All of these require a proof.

Patients of the main group had concomitant hypothyroidism due to: autoimmune thyroiditis (39 people), after surgical interventions on the thyroid gland (9 people), and 12 patients had spontaneous hypothyroidism.

The electrical potential of the brain was recorded using a 21-channel apparatus «Tredex» with computer data processing, the quantitative analysis of encephalograms was optimized, which made it possible to estimate the spectral power and obtain a topographic mapping of the electrical activity of the brain. Standard electrodes were used to measure the indicators, as well as standard functional tests (hyperventilation, closing and opening of the eyes, photo and sound stimulation) and head turns in both directions.

Organic and functional changes in extracranial arteries and the state of cerebral hemodynamics were studied using ultrasound duplex Doppler with spectral analysis of signals [14]. The mean peak systolic blood circulation velocity (V_{ps}), diastolic blood circulation velocity (V_{ed}), peripheral resistance index (Pourcelot, RI – resistive index) and pulsatility index (Gosling, PI – pulsatility index) were studied using spectral analysis of Doppler signals. According to the obtained data were evaluated: the hemodynamic significance of the range of functional capabilities of the arterial bed of the brain, the

severity of disorders, cerebrovascular reactivity and functional insufficiency of the regulation of cerebral blood circulation.

The obtained data were entered into an electronic database and processed by the program «Statistica 6.0» with using parametric and nonparametric methods of variation statistics, so the difference was significant at $p < 0.05$.

RESEARCH RESULTS AND THEIR DISCUSSION

It was revealed according to the results of computerized electroencephalography (CEEG), that in patients with GDE and concomitant hypothyroidism the type III of EEG was prevailed (counted 21 patients (35.1%) (according to A. A. Zhirmunsky), which was characterized by a diffuse desynchronization of waves with a decrease of α -rhythm up to 16–18 μV . In 16 cases (26.6%), there were recorded the type IV, an irregular disorganized α -rhythm with a decrease of an amplitude to 25–27 μV , and in addition slow waves (delta and theta waves), which may indicate the interest of mesodiencephalic structures of the brain. The type II of EEG (hypersynchronous) was recorded in 13 cases (21.7%) of the examined patients with α -rhythm amplitude up to 65–70 μV . The type I of EEG (normal) was recorded in 10 (16.6%) patients.

In patients with GDE without concomitant hypothyroidism the type I of EEG was recorded in 4 cases (10.8%) of the examined patients, the type II of EEG – in 29 cases (72.4%), and the type III of EEG – in 4 cases (10.8%).

Despite the fact that the examined patients had the initial state of the intensity of EEG rhythms in the average physiological limits, however we revealed a significant presence of pathological waves (namely theta waves), irritation of diencephalic structures, and interhemispheric asymmetry ($p < 0.05$) in patients with GDE and concomitant hypothyroidism, who were compared with patients without hypothyroidism (Table 1).

The bioelectrical activity of the brain in patients with GDE and concomitant hypothyroidism was characterized mainly by desynchronization and disorganization of the cortical rhythm. Changes, which were revealed on the EEG, reflected the presence of metabolic and hemodynamic disorders of the brain, which is consistent with the clinical data obtained as a result of the study.

There was revealed a probable increase in peripheral resistance (RI) and pulsatility (PI) indices in the corresponding arteries in the absence of significant changes in peak systolic blood flow velocity, according to the ultrasound duplex scanning of the vessels, the indicators of RI in the common carotid artery and vertebral arteries, PI in the middle cerebral artery in patients with GDE and accompanying hypothyroidism, who were compared with patients with GDE without accompanying hypothyroidism. This indicates a decrease in elasticity and structural changes in the wall of the common carotid artery and vertebral arteries and a decrease in cerebral reactivity accordingly.

Table 1

Characteristics of electroencephalography indicators

Indicators	GDE with hypothyroidism (n=60), M±m	GDE without hypothyroidism (n=37), M±m	P
α-rhythm	0,58±0,06	0,76±0,07	0,138
β-rhythm	0,43±0,06	0,25±0,07	0,134
delta waves	0,16±0,001	0,15±0,001	0,743
Theta waves	0,07±0,003	0,03±0,001	0,015
Irritation of diencephalic structures	0,60±0,06	0,30±0,08	0,023
Interhemispheric asymmetry	0,22±0,05	0,08±0,01	0,016

The peak systolic velocity of blood circulation in the studied main arteries of the examined patients increased ($p<0.05$) in the right common carotid artery, in the left vertebral artery at the level of V4 and in the right vertebral artery at the level of V1-V3. The peak diastolic velocity of blood circulation increased ($p<0.05$) in the right and left vertebral arteries at the level of V4.

During examining patients with GDE and concomitant hypothyroidism there was a correlation (correlation coefficient 0.31-0.37) between the level of pituitary thyroid-stimulating hormone in the blood and the indicators of the average peak systolic blood circulation velocity (Vps) and diastolic blood circulation velocity (Ved) in common carotid artery.

Thus, based on the results of brain electrogenesis, it should be recognized that hypothyroidism negatively affects the functional activity of the brain. This primarily indicates the inadequacy of the blood supply to stem formations with suprasegmental homeostasis regulation centers, which confirms the complexity of the pathogenesis of comorbid pathology. Also, the insufficiency of thyroid hormones in patients with hypertensive dyscirculatory encephalopathy leads to a significant decrease in the elasticity and structural changes of the wall of the carotid and vertebral arteries and to a decrease in cerebral reactivity accordingly.

CONCLUSIONS

1. The comorbidity of GDE and hypothyroidism is manifested by significant changes in the functional activity

of the brain, which is one of the pathogenetic links in the progression of chronic cerebrovascular insufficiency.

2. There is a significant decrease in cerebral blood supply and structural changes in vessels with a decrease in the elasticity of the common carotid artery and vertebral arteries, and a decrease in cerebral reactivity in patients with hypertensive dyscirculatory encephalopathy and accompanying hypothyroidism, according to duplex scanning of brain vessels.

3. The systolic and diastolic speed of blood circulation in the vertebral arteries increases significantly in patients with hypothyroidism, which may be indirectly related to the anatomical and physiological features of the vegetative supply of the thyroid gland and vertebral arteries.

PROSPECTS FOR FURTHER RESEARCH

The lack of thyroid hormones in patients with hypertensive dyscirculatory encephalopathy leads to a significant decrease in cerebral reactivity and changes in the functional activity of the brain, which is one of the main pathogenetic links in the progression of chronic cerebrovascular insufficiency. That is probably potentiated by metabolic changes associated with a decrease in the activity of thyroid hormones and needs further study. The obtained results will make it possible to improve early diagnosis and develop a complex of therapeutic and preventive measures for patients with hypertensive dyscirculatory encephalopathy and accompanying hypothyroidism.

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*Резюме***ОСОБЛИВОСТІ БІОЕЛЕКТРИЧНОЇ АКТИВНОСТІ ГОЛОВНОГО МОЗКУ ТА ЦЕРЕБРАЛЬНОЇ ГЕМОДИНАМІКИ У ХВОРИХ З ГІПЕРТОНІЧНОЮ ДИСЦИРКУЛЯТОРНОЮ ЕНЦЕФАЛОПАТІЄЮ ТА ГІПОТИРЕОЗОМ.****Коваленко О.Є^{1,2}, Литвин О. В.¹**¹Державна наукова установа «Науково-практичний центр профілактичної та клінічної медицини» ДУС, м. Київ.²Національний університет охорони здоров'я України ім. П. Л. Шупика.

Дисциркуляторна енцефалопатія найчастіше зустрічається в осіб працездатного віку. В останнє десятиліття виникло важливе питання взаємозв'язку тиреоїдної та цереброваскулярної патології. Метою дослідження було вивчення особливостей електорогенези головного мозку та церебральної гемодинаміки у хворих з гіпертонічною дисциркуляторною енцефалопатією та супутнім гіпотиреозом.

Було обстежено 97 пацієнтів, з них 60 осіб з ГДЕ та супутнім гіпотиреозом та 37 – з ГДЕ без гіпотиреозу. В результаті дослідження було виявлено, що біоелектрична активність головного мозку у хворих з ГДЕ та супутнім гіпотиреозом характеризувалася переважно десинхронізацією та дезорганізацією кіркової ритміки. Зміни, виявлені на ЕЕГ, відобразили наявність метаболічних та гемодинамічних порушень головного мозку. Також у хворих з ГДЕ та супутнім гіпотиреозом за даними дуплексного сканування судин головного мозку спостерігається достовірне зниження мозкового кровозабезпечення та структурні зміни судин зі зменшенням еластичності загальної сонної артерії та хребцевих артерій і, відповідно, зниження церебральної реактивності.

Таким чином, коморбідність ГДЕ та гіпотиреозу проявляється достовірними змінами функціональної активності головного мозку та зниження церебральної реактивності.

Ключові слова: гіпертонічна дисциркуляторна енцефалопатія, гіпотиреоз, електроенцефалографія, дуплексне сканування судин, церебральна реактивність.