

перенесенной ЧМТ выявлено статистически достоверное увеличение удельного веса  $\beta$ -ритма и медленно-волновой активности  $\delta$ - и  $\theta$ -диапазонов, уменьшение доли  $\alpha$ -ритма и увеличение коэффициента асимметрии  $\alpha$ -ритма. Для пациентов в отдаленном периоде ЧМТ характерно удлинение латентных периодов промежуточных и поздних компонентов зрительных вызванных потенциалов. Для пациентов в отдаленном периоде ЧМТ характерны значительные изменения спонтанной и вызванной биоэлектрической активности головного мозга, часть из которых ухудшаются с повышением тяжести перенесенной травмы.

### Summary

CHARACTERISTICS OF NEURODYNAMIC CHANGES IN BRAIN DEPENDING ON SEVERITY OF TRAUMATIC CRANIOCEREBRAL INJURY  
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Key words: craniocerebral injury, electroencephalography, visually evoked potentials.

Various types of the courses of traumatic disease of the brain, and a wide range of long-term effects of craniocerebral injury (CCI) determine the necessity to improve approaches to their diagnosis and treatment. *Aim.* To specify neural changes in the brain in patients in long-term period of CCI depending on the severity of the trauma. *Materials and methods.* We examined 100 patients with long-term consequences of CCI and divided them into three groups depending on the severity of trauma. Electroencephalography (EEG) analysis with classification of EEG type according to Zhyrmunsky was performed for all the subjects under the study. In addition, the evaluation of long latency components of the visually evoked potentials was performed in the group of 30 patients. *Results.* Statistically significant changes occur in the distribution of EEG types in the patients with long-term consequences of CCI with an increase in the severity of trauma. The number of patients with the organized  $\alpha$ -rhythm was significantly reduced due to the proportional increase in patients with desynchronism, disorganized and severely disorganized types of EEG pattern (III, IV and V types of EEG according to Zhyrmunsky). Amplitude and frequency parameters of the main EEG rhythms between the groups of patients with different severity of CCI in the past history did not differ significantly. We established a statistically significant increase in the proportion of individuals with  $\beta$ -rhythm and slow-wave activity of  $\delta$ - and  $\theta$ -ranges, along with a decrease in the proportion of  $\alpha$ -rhythm and increased asymmetry of  $\alpha$ -rhythm with increasing severity of TBI. EEG is characterized by the elongation of the latency periods of intermediate and late components of visual evoked potentials in patients in the long-term period of CCI. *Conclusion.* Significant changes in spontaneous and evoked bioelectric activity of the brain are specific for patients in the long-term period of CCI, some of which worsen with increasing severity of trauma.

UDC 616.12-073.97:[616.127-02:616.441-008.61:616.12-008.331.1

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## **HOLTER ECG MONITORING AND ASSESSMENT OF THE HEART RATE VARIABILITY IN THE DIAGNOSTICS OF THE THYROTOXIC CARDIOMYOPATHY WITH SECONDARY ARTERIAL HYPERTENSION**

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*The paper presents the results of study of the diagnostic capabilities of Holter ECG monitoring and assessment of heart rate variability in patients with thyrotoxic cardiomyopathy and secondary arterial hypertension. This study demonstrates the high efficiency of the use of these instrumental methods in diagnosis of structural, metabolic and regulatory disorders of the cardiovascular system in patients with thyrotoxic cardiomyopathy and secondary arterial hypertension. This technique enables to carry out dynamic monitoring of the effectiveness of the therapy and to plan post-hospital rehabilitation.*

Key words: thyrotoxic cardiomyopathy, secondary arterial hypertension, Holter ECG monitoring, assessment of heart rate variability

*This work is a fragment of the complex research project "characteristics of comorbidity courses of internal diseases, risk factors and mechanisms of mutual aggravation, pharmacotherapy», state registration number 0114U002475.*

### Introduction

Thyrotoxic cardiomyopathy (thyrotoxic heart - TH) is a very common chronic condition in the group of metabolic and endocrine cardiomyopathies and is considered the one of the challenges of cardiology [nowadays [3, 6, 9]. TH is becoming the leading syndrome of the thyroid hyperfunctional diseases accompanied by the development of arrhythmias, secondary arterial hypertension, heart failure, etc. [4, 5, 12, 16]. It has been established that the TH develops mainly in young working-age

population with thyrotoxicosis, and often does not acquire the full reverse development even in hyperthyroidism compensation. It is usually characterized by chronic, progressive course [11, 13, 15, 17].

Application of non-invasive instrumental methods of diagnoses of cardiac diseases (Holter monitoring (HM) of ECG and assessment of heart rate variability (HRV)) allows us to objectify and specify metabolic, hemodynamic and autonomic disturbances in TH to optimize the treatment of these patients [1, 7, 8]. In addition, the use of these methods in complex diagnoses of the TH and during treat-

ment helps to evaluate the effectiveness of prescribed therapy, to develop objective selection criteria of drug doses, to conduct monitoring of treatment and rehabilitation of patients with TH [10, 14].

### **The purpose of the study**

To evaluate the diagnostic capabilities of Holter monitoring of ECG and assessment of heart rate variability in the diagnosis and dynamic monitoring of the thyrotoxic heart with secondary arterial hypertension.

### **Materials and methods**

The study included 53 patients with clinical presentations of TH and secondary arterial hypertension (38 women and 15 men) aged from 25 to 66 years (mean age was  $44.3 \pm 5.5$  years). The control group consisted of 25 individuals without identified somatic pathology (20 women and 5 men) with the mean aged  $41.3 \pm 2.6$  years.

The diagnosis of TH and secondary arterial hypertension was established after standard clinical and instrumental examinations. We did not include to the study patients with cardiovascular pathology (ischemic heart disease, myocardial infarction, congenital and acquired heart diseases, essential arterial hypertension), diabetes mellitus, obstructive lung disease, and severe kidney and liver disorders.

Holter monitoring of ECG and assessment of HRV were carried out according to the recommendations of experts of the European Society of Cardiology and North American Society of Pacing and Electrophysiology (1999) [2] on the device "Diacard" AO "Solweig" (Ukraine) at the beginning of in-patient treatment and in 10-14 days after the admission from the hospital. We analyzed the characteristics and source of rhythm, average, maximum and minimum heart rate per day and per hour, the frequency and characteristics of arrhythmias, the level of elevation and depression ST-segment depending on the physical, emotional activity, level of arterial pressure, and use of medication.

The following parameters of HRV were determined: time parameters - SDNN index (ms), RMSSD (ms), and pNN50 (%); spectral parameters - high-frequency component of the spectrum, HF ( $\text{ms}^2$ ), low frequency component of the spectrum - LF ( $\text{ms}^2$ ), and very low frequency component VLF ( $\text{ms}^2$ ). Also we analyzed the LF/HF ratio like an indicator of the balance of sympathetic and parasympathetic autonomic regulation. For determination of the spectral parameters, we used nonparametric method of fast Fourier transformation. We also measured statistical parameters: the amplitude of mode ( $\text{AM}_O$ , %) and the Bajevsky index (IB, U).

### **Results and discussion**

Criteria for diagnosis of TH with secondary arterial hypertension included clinical findings, anamnesis, objective and subjective data of the cardiovascular system pathology, level of BP elevation, ECG data (rhythm and conduction disorders, myocardium hy-

per trophy), Echocardiography data (hyper- or hypodynamic syndrome, hypertrophy of heart walls, dilatation of the heart cavities, mitral valve prolapse) in the presence of hyperfunction of the thyroid gland (confirmed by the elevated levels of  $T_3$ ,  $T_4$  or decreased serum concentration of TSH).

During the daily HM of ECG the significant increase in average, minimum and maximum heart rate were revealed in all patients. Absence of significant decrease in heart rate at night was suggested as a manifestation of hyperdynamic syndrome. Different disorders of the heart functions (automatism, excitability and conductivity) were evaluated as a result of the morphological heterogeneity of the myocardium and development of cardiosclerosis, diffuse disorders of repolarization as a consequence of metabolic disturbances in the heart muscle. The level of maximum heart rate in the studied patients was  $152.14 \pm 3.60$  per minute. Ventricular extrasystole was detected in 49% of patients, the number of extrasystoles per day was  $25.30 \pm 5.65$  and does not go beyond a low-grade classes. Atrial extrasystole was detected in 64% of patients, and the number of extrasystoles per day was  $104.52 \pm 11.61$ ; 19% of patients recorded both versions of extrasystoles. Disturbances of repolarisation in HM of ECG was recorded in all patients in form of ST-segment depression and flattened or biphasic T-wave that can be assessed as a significant impairment of myocardial metabolism in patients with TH and secondary arterial hypertension.

Daily analysis of HRV revealed the pronounced increase in sympathetic influence on the cardiac activity regulation (increase of  $\text{AM}_O$  ( $63,45 \pm 1,85$  %), IB ( $454,34 \pm 25,37$  U), the relative increase of the LF and VLF spectral components) and inhibition of the parasympathetic part of autonomic regulation (decrease of RMSSD ( $14,25 \pm 0,56$  ms), pNN50% ( $1,68 \pm 0,54$  ms), HF spectral component ( $121,18 \pm 10,17$   $\text{ms}^2$ )) on the basement of decrease of the total HRV (SDNNi decrease to  $26,21 \pm 1,64$  ms) and the total power of spectrum. The detected levels of analyzed parameters were significantly different from those in the control group ( $p < 0,05$ ).

To estimate the relationships between the obtained parameters of HRV, medical history (disease duration), clinical data (heart rate, BP) and laboratory parameters ( $T_3$ ,  $T_4$ ), multivariate correlation analysis was applied. There were revealed moderate and strong positive relationship between the  $T_3$ ,  $T_4$  levels and heart rate ( $r=0,55$ ), between the  $T_3$ ,  $T_4$  levels and indicators of sympathetic activity (LF,  $\text{AM}_O$ ) ( $r= 0.52-0.53$ ), between the heart rate level and indices of sympathetic activity (LF,  $\text{AM}_O$ ) ( $r=0.54$ ). Strong positive correlation between duration of disease and indicators of sympathetic activity (LF,  $\text{AM}_O$ ) ( $r=0.55$ ) was detected together with the strong positive correlation between level of the blood pressure and indices of sympathetic activity (LF,  $\text{AM}_O$ ) ( $r= 0.67-0.55$ ). Moderate and strong negative correlation was revealed between the total variability, the parasympathetic activity (SDNNi,

RMSSD, HF) and the T<sub>3</sub>, T<sub>4</sub> levels in the blood (r = -0,46 – -0,49), and the level of heart rate (r = -0,57 – -0,6), moderate negative correlation between disease duration and spectral index of parasympathetic activity (HF) (r = -0,45).

Dynamic monitoring revealed significant positive changes of HRV parameters, but indicators of the total variability and parasympathetic activity (SDNNi and RMSSD, pNN50%, HF) remained significantly below normal. Indicators of sympathetic activity (AMo, IB) became normalized faster and were compared with control level. Spectral data did not reach the level of control during investigation. That was expressed in reduction of the total power of spectrum in comparing with levels of control due to the decrease in the content of its components. However, a relative index of the autonomic regulation balance (LF/HF) became normal (and was even below the level of control). Tendency of HRV parameters normalization depended of the BP level of investigated patients. Thus, analyzing the obtained data, the therapy of TH with secondary arterial hypertension was assessed as adequate and effective, it was recommended to be continued during post-hospital stage of treatment.

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### Реферат

ХОЛТЕРІВСЬКЕ МОНІТОРУВАННЯ ЕКГ ТА ОЦІНКА ВАРІАБЕЛЬНОСТІ СЕРЦЕВОГО РИТМУ В ДІАГНОСТИЦІ ТИРЕОТОКСИЧНОЇ КАРДІОМІОПАТІЇ З ВТОРИННОЮ АРТЕРІАЛЬНОЮ ГІПЕРТЕНЗІЄЮ

Шупер В.О., Шупер С.В.

Ключові слова: тиреотоксична кардіоміопатія, вторинна артеріальна гіпертензія, Холтерівське моніторування ЕКГ, оцінка варіабельності серцевого ритму.

В роботі представлені результати дослідження діагностичних можливостей Холтерівського моніторування ЕКГ та оцінки варіабельності серцевого ритму у хворих з тиреотоксичною кардіоміопатією і вторинною артеріальною гіпертензією. Проведені дослідження демонструють високу ефективність використання зазначених інструментальних методів дослідження в цілях первинної діагностики структурних, метаболічних та регуляторних порушень стану серцево-судинної системи у хворих із тиреотоксичною кардіоміопатією і вторинною артеріальною гіпертензією, а також для проведення динамічного моніторингу ефективності проведеної терапії та планування постстаціонарного лікування.

### Реферат

ХОЛТЕРОВСКОЕ МОНИТОРИРОВАНИЕ ЭКГ И ОЦЕНКА ВАРИАБЕЛЬНОСТИ СЕРДЕЧНОГО РИТМА В ДИАГНОСТИКЕ ТИРЕОТОКСИЧЕСКОЙ КАРДИОМИОПАТИИ С ВТОРИЧНОЙ АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

Шупер В.А., Шупер С.В.

Ключевые слова: тиреотоксическая кардиомиопатия, вторичная артериальная гипертензия, Холтеровское мониторирование ЭКГ, оценка вариабельности сердечного ритма.

В работе представлены результаты исследования диагностических возможностей Холтеровского мониторирования ЭКГ и оценки вариабельности сердечного ритма у больных с тиреотоксической кардиомиопатией и вторичной артериальной гипертензией. Проведенные исследования демонстрируют высокую эффективность использования указанных инструментальных методов исследования в целях первичной диагностики структурных, метаболических и регуляторных нарушений состояния сердечно-сосудистой системы у больных с тиреотоксической кардиомиопатией и вторичной артериальной гипертензией, а также для проведения динамического мониторинга

ефективності проводимої терапії и планирования постстационарного лечения.