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RELATIONSHIP OF THE GEOMAGNETIC DISTURBANCE TO THE STATE OF THE CARDIOVASCULAR SYSTEM AT HIGH LATITUDES ON THE GROWTH PHASE OF THE 11-YEAR SOLAR ACTIVITY CYCLE

ABSTRACT

Aim. To determine the dependence of the cardiovascular system's changes on specific physical parameters of space weather.

Materials and methods. The research covered 47 volunteers of different age, gender, and health conditions. The research was conducted at two observing stations: in the city of Yakutsk and the settlement of Tiksi in the Far North. For two months in March and April of 2011, on weekdays, we did ECG of the volunteers with Phasagraph system.

Results. It was revealed that the test people organisms react with changes in the T-wave symmetry on each change in the geomagnetic storminess.

Conclusion. The existence of coincident peaks of ECG data changes with geomagnetic parameters at the two observing stations proves the impact of the changes in geomagnetic storminess on the human cardiovascular system. The contrasting of the research results to the 2009 experiment results assumes that the different reactions of the human cardiovascular system may be related to the different phases of the 11-year Solar cycle.

Keywords: cardiovascular system, electrocardiogram, degree of symmetry, Solar activity, geomagnetic storminess.

The term 'space weather' describes the state of the near-Earth space. The Sun has the main impact on the near-Earth space. Therefore, identifying the link mechanisms between the solar activity and the functioning of various objects of the biosphere, including humans, is one of the fundamental issues of modern science.

The human organism is an open system; thus, changing conditions in the external environment have an impact on human well-being. The cardiovascular system is one of the first to participate in the process of adapting to changing environmental conditions. This is manifested in changes in the circulatory system, in particular, in the vascular tonus and blood rheological properties, as well as a disturbed balance between the coagulation and anticoagulation systems [4]. Cardiovascular diseases rank first in the morbidity and mortality of people; therefore, these diseases are socially significant and require more attention [5].

Living organisms on Earth are under the constant influence of environmental factors [1]. They include both widely known meteorological factors (temperature, pressure, wind, and humidity) and less known factors of electromagnetic nature, whose influence is not felt until their intensity reaches a certain level. The factors of electromagnetic nature change primarily under the influence of the Sun on the magnetic field, gaseous mantle and solid crust of the Earth [6]. To date, a large body of scientific information on the matter is accumulated. However, the conclusions of individual authors are contradictory. For example, Yu. I. Gurfinkel et al. [2] claim that the impact of geomagnetic storminess on the cardiovascular system of a patient with coronary artery disease is most pronounced during the first three days after the storm beginning. Meanwhile, E. I. Nesmeyanovich and A. V. Bukalov [3] conclude that the heart attacks dynamics is not correlated with the dynamics of storminess of the Earth magnetic field; they note that the highest number of heart attacks occur 9-10 days prior a geomagnetic storm.

Thus, the results of individual authors on the reaction of the human body to heliogeophysical disturbances do not always agree with each other.

The aim of the present research was to determine the dependence of the cardiovascular system's changes on specific physical parameters of space weather.

MATERIALS AND METHODS

To address this aim, in the period March-April 2011, we carried out a biomedical monitoring experiment to check the cardiovascular system state of volunteers with Phasagraph express-cardiograph.

At two stations: in the city of Yakutsk – Shafer Institute of Cosmophysical Re-

search and Aeronomy (ICPRA) and the Medical Institute, Ammosov North-Eastern Federal University (MI NEFU); and in the settlement of Tiksi – the ICPRA Observatory, the measurements were taken on a daily basis with the same equipment (Phasagraph system) following the same study protocol in groups of volunteers recruited at each observing station. All measurements were sent to the united database on Geliomed portal, where they were processed by the same method, which excluded the introduction of subjective factors with local processing of the measurement results at the observing stations.

As an experimental material, we used the data of the first electrocardiogram (ECG) leads of the volunteers with subsequent calculation of the T-wave symmetry characterizing the cardiovascular system functional state. Kp-index was used as a measure of geomagnetic activity.

The experiment covered 47 volunteers of different age, gender, and physical conditions. During two months in March and April 2011, on weekdays, we did ECG test on a daily basis using Phasagraph system. The ECG data were recorded under 4 loads: 0 load - measurement of the heart rate at rest, 1 - after an exercise same for all participants of the experiment, 2 - after emotional load, 3 - after a 10 minute rest.

When processing the medical data, we received an individual data range for each patient, for the entire period of the experiment and each load. Then, in order to create a continuous series of the data, we interpolated the parameters of each volunteer. In order to smooth the variations in the geomagnetic storminess index and the T-wave symmetry (TWS), the data were filtered to eliminate oscillation with a period of less than 4 days.

RESULTS AND DISCUSSION

The comparison of TWS temporal variations for each tested person under 4 loads with the temporary variations in the geomagnetic storminess index showed the coincidence of these figures in half of the tested people in the MI and Tiksi groups. However, the ICPRA group demonstrated only a partial coincidence of the experimental data. It was found that the best agreement is observed for 0 and 3 measurement modes, corresponding to the state of rest and the state in 10 minutes of rest after physical activity. This means that the tested people felt changes in geomagnetic storminess more at the state of rest. The average age of the tested people with the same changes in the MI group was 22 years old. The average age of the participants with overlapping changes in the ICPRA group amounted to 47.8 years. In the Tiksi group, the average age of the participants with the same changes was 39.8 years, and the average age of the participants with overlapping changes was 43.1 years.

In Figure 1, the vertical axis shows the average index of the T-wave symmetry during ECG test under load 0 in relative units (the solid line) and Kp-index of geomagnetic storminess; the horizontal axis indicates the time in days from the beginning of the experiment. The figure shows that almost every change in geomagnetic storminess resulted in similar changes in TWS. The presence of coincident peaks of the medical data changes with geophysical parameters at the two observing stations shows the impact of changes in geomagnetic storminess on the human cardiovascular system.

During a similar comparison of the medical data from Tiksi, MI and ICPRA with Kp-index of geomagnetic storminess in 2009, the following results were obtained: a coincidence was marked in temporary variations of the T-wave symmetry in half of the volunteers at the observing station in Yakutsk (ICPRA and MI groups) with Kp-index, at low levels of geomagnetic storminess. At observing station in Tiksi, the comparison of the medical and geophysical data identified a group of people with TWS changes that coincided with the variations of geomagnetic activity only partially. Such a difference in the results may be due to the fact that the observations were conducted at different years of the solar activity. The year 2009 was considered a year with minimum solar activity, whereas the year 2011 signaled the beginning of solar activity growth.

Conclusion

1. There were revealed coinciding peaks of temporal changes in geomagnetic storminess and TWS in half of the volunteers in the MI group (Yakutsk) and Tiksi, who participated in the experiment. Basing on this, the assumption is made about the dependence of the human cardiovascular system on geomagnetic storminess.

2. The year of solar activity growth showed better tracking of variations in geomagnetic activity in young tested people (MI) and the group of volunteers in the Arctic region (Tiksi). The comparison of the results of this experiment with the experimental results of 2009 suggests that the different reactions of the cardiovascular system may be associated with a certain phase of the 11-year Solar cycle.

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PREVALENCE AND RISK FACTORS OF ACID DISEASES IN THE ADULT POPULATION OF THE REPUBLIC SAKHA (YAKUTIA)

ABSTRACT
In order to study the prevalence of risk factors of acid diseases in the adult population according to the residence area in the Republic Sakha (Yakutia), we surveyed men and women aged 45-70 years, living in the Arctic and Central Yakutia. We concluded that prevalence of symptoms of acid disorders was 53%, more often in the living in the Arctic. We revealed the high prevalence of chronic atrophic gastritis, Helicobacter pylori infection and poor dental health. Some risk factors for these disorders are modifiable, allowing to plan in their relation therapeutic and prophylactic measures.
Keywords: acid disorders, gastroesophageal reflux disease, population, prevalence, risk factors.

INRODUCTION

Acid-related diseases are the cause of diseases of the stomach, duodenum (peptic gastric and duodenal ulcer disease, erosive and ulcerative lesions, chronic gastritis, gastroduodenitis, syndrome of non-ulcer functional dyspepsia), esophagus (gastroesophageal reflux disease -GERD, which occupies one of the first places). The true prevalence of GERD is poorly studied. This statement is connected with a great variability of clinical manifestations - from occasionally arising heartburns at which patients rarely go to the doctor, to the bright signs of complications of reflux esophagitis [1, 5].

In recent years, there is a clear downward trend in the number of patients with peptic ulcer disease on the background of increased number of patients suffering from GERD, which gave reason to declare this pathology a disease of the 21st century at the VI united Gastroenterological Week held in Birmingham in 1997. The term "reflux disease" was proposed in the mid 60s of the 20th century and involves a combination of the clinical picture of the disease and its associated morphological changes - reflux esophagitis, which has occurred as a result of continuous flow back in the esophagus of gastric or intestinal content, bile and pancreatic juice. GERD as an independent nosological unit officially was recognized in 1997 in the Belgian town of Genval at a conference devoted to the diagnosis of the disease [3, 5]. In accordance with the WHO classification of GERD – it is a chronic relapsing disease caused by a violation of the motor-evacuation function of the gastroesophageal zone and characterized by spontaneous and (or) regularly repeated throwing up into the esophagus gastric or duodenal content, resulting in damage to its distal department.

As for dyspepsia it is a syndrome, including pain or burning in the pit of the stomach, heaviness and fullness in the epigastrium after eating, early satiety, bloating, nausea, and vomiting, belching and some other symptoms. In Western Europe, functional dyspepsia is found in 30-40% of the population, it is the cause of 4-5% of all visits to the doctor. In the USA and UK dyspeptic symptoms bother respectively 26 and 41% of the population.

Heartburn and acid regurgitation are the main symptoms of acid disorders. The prevalence of heartburn in the USA, the UK and Finland amounted to 24-36%, when it concerned of heartburn in general, and 10-21% of the population had heartburn weekly [5].

The foreign and domestic statistical studies report, that almost every tenth citizen of the European countries, the USA and Russia suffers from peptic ulcer disease (GU) of the stomach and duodenum, and the prevalence of GERD in adults is about 40% and 30% in Yakutia [1, 3, 5].

Here is some information about geographical position of the Republic Sakha (Yakutia). It occupies a vast territory, more than 40% of it lies above the Arctic Circle. Central Yakutia area includes Yakutsk and its suburbs, as well as the areas located in the basins of the Lena river flow, Viluy, Lena-Amga interfluve. Anabar, Nizhnekolymsky, Allaikhovskiy, Bulunsky and Ust-Jansky areas, situated along the shores of the Arctic Ocean, refer to the number of Arctic regions. In the Arctic low temperature is accompanied by strong winds. In the period from November to January polar night falls over a large territory. According to the complex of natural factors that affect the human body, this region is very harsh to live.

The **aim** of this study was to investigate the prevalence of acid diseases and risk factors among the population of Yakutia living in the various climate areas.

MATERIALS AND METHODS

We studied 2 groups of population – those, living in Central Yakutia and in the Arctic. In Central Yakutia survey was carried out among the indigenous population of two villages, in total 133 people (63 men and 70 women) aged 45-70. In Arctic villages we surveyed 131 people (31 and 100), aged 45-70 years. To identify the symptoms of the disease we used gastroenterological questionnaire, there was also conducted blood sampling and 40 people underwent endoscopy. Infection with Helicobacter pylori (Hp) we assessed using a test