

RESEARCH ARTICLE

Impact of heliogeophysical factors on clinical and biochemical parameters in males suffering from blood thrombangiitis

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The influence of solar and geomagnetic activity factors on clinical and biochemical parameters of patients with obliterating thrombangiitis consists of immediate and delayed reactions with different latent periods. The most pronounced reactions to current events and moderate reactivity to events during the week before the survey. Highly reactive parameters are Na + blood (CD = 35.5%) and total serum protein (CD = 26%), while the nonreactive index – urine amylase. Among the patients with obliterating thrombangiitis, there were 5 types of reactions to fluctuations of solar and geomagnetic activity factors, including 2 types at low and 3 types at medium level of solar and geomagnetic activity. Accordingly, for each typological group non-linear functional dependences of indicators are established.

Keywords: obliterating thrombangiitis; geomagnetic activity; solar activity; cardiovascular pathology

Introduction

Long-term clinical observations and scientific studies of a number of authors show that the course and exacerbation of cardiac and vascular pathologies are often associated with fluctuations in solar and geomagnetic activity (Mikulecký, Strestík, 2007; Samsonov et al., 2008; Vencloviene et al., 2013; Bazhenov et al., 2014; Vencloviene et al., 2014; Shaposhnikov et al., 2014; Stoupel, 2016). Nevertheless, it is difficult to clearly determine the degree of influence of this category of factors in the total set of impacts that a person faces in everyday life. The complexity of such studies lies in the nature of the body's response to changes in the studied factors, which is expressed both in the immediate action and in the launch of biological reactions that occur only a few days later. Therefore, it is necessary to analyze the current day and the previous period. In addition, most of these relationships are characterized by nonlinearity and multifactorial nature, which requires the use of adequate methods of analysis (Andronova et al., 1982).

In the Altai region, a fairly common cardiovascular disease is obliterating thrombangiitis. Thromboangiitis obliterans should be attributed to the diseases of polyetiological genesis caused by a combination of genotypic and phenotypic factors, among which an important role belongs to environmental factors (Mikheev et al., 2002). Therefore, this category of people was considered as highly sensitive to the action of these factors.

In this regard, the purpose of the work was to analyze the influence of solar and geomagnetic activity factors on the clinical and biochemical parameters of patients with thromboangiitis obliterans.

Materials and methods

The study involved 91 males aged 17 to 61 years, the average age was 42.8 ± 0.7 years. 13 clinical and biochemical parameters of blood were determined: the content of total protein, total cholesterol, urea, bilirubin common, fibrinogen, glucose, hemoglobin, K^+ and Na^+ , hematocrit number, erythrocyte sedimentation rate (ESR), prothrombin activity, the number of leukocytes, as well as urine amylase.

To characterize the level of solar and geomagnetic activity, the following were used: the Wolf number, the number of sunspots, radiation at a wavelength of 10.7 cm, and the average daily characteristic of the Earth's magnetic field perturbation (Ar-index) (Dubov, Khromova, 1992). Information about heliogeophysical factors during the study period obtained from the monthly SolarGeophysicalDataNoAAUSA bulletins (<http://spidr.ngdc.noaa.gov>).

The results of the clinical and biochemical examination of patients with thromboangiitis obliterans were correlated with solar and geomagnetic activity per day and during the week before the examination.

Statistical processing of the data was carried out using the methods of descriptive statistics, correlation analysis - correlation ratio(h) and determination coefficient (CD) and cluster analysis of k-means.

Results and discussion

The results of clinical studies of thrombangiitis obliterans patients blood indicate that the average values of clinical and biochemical parameters are within normal limits, with the exception of ESR and total cholesterol levels. ESR was higher and total cholesterol lower than in healthy men (table. 1).

Table 1. Mean values of clinical and biochemical parameters in the group of patients with obliterating thrombangiitis

Clinical and biochemical parameters	Value	
	Norm (for men)	Patients with obliterating thrombangiitis (M ±m)
Na ⁺ blood, mmol	130 – 156	135.42±0.31
Bilirubin common, μmol	8.5 – 20.5	15.70±0.59
Hematocrit number	0.40 – 0.48	0.46±0.01
Hemoglobin, g/l	132 – 164	146.99±1.54
Urine amylase, VE	16 – 64	24.88±0.90
K ⁺ blood, mmol/l	3.4 – 5.3	4.31±0.05
Leukocytes, 10 ⁹ /l	4 – 8.8	7.05±0.25
Blood urea, mmol/l	2.5 – 8.3	5.44±0.13
Total serum protein, g/l	65 – 85	72.89±0.62
Protrombin activity, %	95 – 100	84.40±1.29
Glucose, mmol/l	3.5 – 5.7	4.98±0.14
Erythrocyte sedimentation rate, mm/h	1 – 10	11.29±1.03
Fibrinogen g/l	2 – 4	3.37±0.09
Total cholesterol, mmol/l	5.5 – 7.2	4.52±0.12

The incidence of obliterating thrombangiitis is subject to pronounced fluctuations, the causes of which are not clear (Shabanov et al., 1983). The study found that the number of patients admitted to the hospital is associated with fluctuations in solar activity ($h = 0.78$, $p < 0.05$). The studied clinical and biochemical parameters in patients with obliterating thrombangiitis have correlations with the index of solar and geomagnetic activity on the day of examination and during the weekly history.

The greatest number of maximum dependencies of clinical and biochemical parameters with the Wolf number and the average daily characteristic of the magnetic field perturbation (Ap-index) was observed on the day of the survey, with the value of radiation at a wavelength of 10.7 cm - on the day and during the week before the survey. It can be said that the manifestation of the trait is influenced not only by the events that took place on the Sun on the day of the survey, but also by the events observed during the week before the survey. In relation to the effects of solar and geomagnetic activity, clinical and biochemical parameters of blood are divided into three categories: highly reactive (have correlation with all heliogeophysical indices), medium-active (correlation with individual indices), and reactive (have no reliable correlation with any of the indices under consideration).

Among the clinical and biochemical parameters highly reactive to the factors of solar and geomagnetic activity were the total protein and the level of blood serum Na⁺, which have correlations with all the considered indices and the highest values of the coefficients of determination. The reactive parameter is urine amylase ($p > 0.05$). Other indicators have correlations with separate indices of solar and geomagnetic activity, i.e. they belong to the group of average active indicators (table. 2).

To identify typologies of response to fluctuations in solar and geomagnetic activity in patients with obliterating thrombangiitis, we used a multidimensional version analysis, which allows us to identify a combination of several indicators. The results of the cluster analysis show that in some cases the average values of the neighboring clusters did not differ significantly, so the minimum and maximum values of each of the studied indicators were taken into account.

It should be noted that the period of this study was characterized by moderate solar activity. Therefore, the five groups that were obtained as a result of cluster analysis are divided by the level of solar and geomagnetic activity.

Among the men examined during the period of low solar and geomagnetic activity, two groups were distinguished. The first group is characterized mainly by the average values of clinical and biochemical parameters relative to other groups, but the maximum level of blood serum K⁺ (4.42 ± 0.11 mmol/l). In the second group observed the minimum content of bilirubin common (12.03 ± 0.70 μmol/l), glucose (4.48 ± 0.25 mol/l), K⁺ (4.14 ± 0.13 mmol/l) and Na⁺ (134.29 ± 0.70 mmol/l), serum total protein (69.84 ± 1.54 g/l) and hemoglobin (126.55 ± 4.79 g/l), viscoelasticity number (0.40 ± 0.01) and minimal prothrombin activity (of $80.59 \pm 4.52\%$), but the maximum content of fibrinogen (4.08 ± 0.33 g/l), urine amylase (30.02 ± 1.76) and the value of the erythrocyte sedimentation rate (23.53 ± 3.55 mm/h) compared to other clusters.

Among the men examined during the period of average solar and geomagnetic activity, three groups were distinguished. In the first group there is a maximum serum total protein content (76.49 ± 1.69 g/l), hematocrit number (0.51 ± 0.01), but the minimum content of total cholesterol (4.12 ± 0.24 mmol/l), urine amylase (20.46 ± 2.23), fibrinogen (of 2.81 ± 0.15 g/l), blood leucocytes (5.62 ± 0.33 10⁹/l) and erythrocyte sedimentation rate (4.50 ± 0.86 mm/h).

Table 2. Determination coefficients ($p < 0.05$) of clinical and biochemical parameters from solar and geomagnetic activity factors in patients with obliterating thrombangiitis

Clinical and biochemical parameters the	Coefficient of determination. %
Na ⁺ blood	34.3
Total serum protein	26.0
Fibrinogen	17.3
Total cholesterol	13.8
Protrombin activity	10.8
Blood urea	10.8
K ⁺ blood	9.0
Leukocytes	7.8
Erythrocyte sedimentation rate	5.8
Hemoglobin	4.5
Bilirubin common	4.5
Hematocrit number	3.5
Glucose	3.0
Urine amylase	0

The second and third groups are characterized by the predominance of high values of clinical and biochemical parameters. In the second group observed the maximum levels of bilirubin common (18.03 ± 2.22 mmol/l), glucose (5.60 ± 0.27), protrombin activity (86.38 ± 1.65 %) and the minimum content of blood urea (4.61 ± 0.10). The third group is characterized by the maximum content of total cholesterol (5.50 ± 0.75 ml/l), blood urea (7.71 ± 0.74 mmol/l), Na⁺ (137.13 ± 0.85 mmol/l), hemoglobin (159.13 ± 4.04 g/l) and leukocytes ($9.34 \pm 1.37 \times 10^9/l$) in blood, as well as prothrombin activity (86.38 ± 2.59 %). Clinical and biochemical parameters with low values of the third group are absent.

Conclusion

The influence of heliogeophysical factors on clinical and biochemical parameters of obliterating thrombangiitis patients consists of immediate and delayed reactions with different latent periods. The most pronounced reactions to current events and moderate reactivity to events during the week before the survey. Highly reactive indicators are Na⁺ blood ($K = 35.5\%$) and total serum protein ($K = 26\%$), while the reactive indicator is urine amylase. Among patients with obliterating thrombangiitis, 5 types of reactions were distinguished, including 2 types at low and 3 types at medium level of solar and geomagnetic activity. Accordingly, in each typological group non-linear functional dependences of indicators on the factors of solar and geomagnetic activity are revealed.

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