Research Paper

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Comorbidity in Hypertensive Inhabitants of the North

Medical Science

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ABSTRACT

It has been shown that the climate-geographic stress in the hypertensive patients in the North is accompanied by a significantly greater severity of comorbidity than in similar hypertensive patients living in the middle latitudes. It has been also found that severity of combined pathological disorders in high latitudes depends on the level of cortisol increase in the blood, the degree of psychoemotional stress and desynchronosis increase, especially in people with "morning" chronotype. It was revealed the high dependence of diastolic blood pressure increase and adaptive-restoring potential decrease in the northern patients on the level of desynchronosis. The highest level of comorbidity has been found in the hypertensive patients in the North with a strong resistance to the development of desynchronosis.

Introduction

Recent scientific research data in the North allowed determine that high incidence of morbidity, premature aging, reduction of life duration in non-indigenous population is associated with development of chronic northern stress under the influence of the extreme climatic and geophysical factors of high latitudes (Hasnulin, 2012). Northern stress, accelerating the exhaustion of organism's adaptive reserves, leads to development of disadaptive disturbances cascade, and then becomes a cause of formation of associated pathological conditions. These pathological conditions are combined by common pathogenetically connected mechanisms, starting with molecular-cellular disturbances in most organs and systems under the influence of extreme changes in geophysical and meteorological factors of high latitudes.

However, at present the problem of associated (comorbid) conditions in the North, biologically expediency of their formation, mechanisms of individual resistance to progression of associated pathology have not practically solved. In this regard in our studies we have set the task to study the relationship of severity of comorbidity with manifestations of chronic northern stress, to determine the value of comorbid states in formation of desynchronosis and to assess significance of individual chronotype in providing resistance to desynchronosis in high latitudes.

Material and methods

It was surveyed a random sample of 238 men – non-indigenous inhabitants of Norilsk, patients with hypertension I-II stages, in the clinic of Scientific-Research Laboratory of Polar Medicine, SB RAMS. 60 non-indigenous inhabitants of the North and 119 inhabitants of middle latitudes, hypertensive patients, who came to the resort treatment in the resort Belocuriha, were examined. The age of the patients was in the range of 22-59 years with a mean age – 44.1±0.5 years.

The study has been performed according to the ethical standards laid down in the Helsinki Declaration (1964; 2000) and has been approved by the appropriate ethics committee.

Common clinical, functional and laboratory diagnostic methods were used. Comorbidity was estimated according to the generally accepted method of comorbidity measurement – CIRS system – Cumulative Illness Rating Scale (Linn, 1968; De Groot, 2003).

Psychophysiological and chronobiological parameters were determined using computer program "SCREENMED" (SCCEEM SB RAMS, state registration № 970035 from 29.01.1997). To determine the severity of psychoemotional stress Spielberg-Hanin and Luscher psycho-tests were used. Assessment of "biological" time was held with the use of the test to determine the exactness of subjective perception and reproduction of time intervals (test of individual minute). The degree of synchronization of endogenous and exogenous rhythms was determined by a combination of acceleration or deceleration of "biological" time in relation to the real time with increase or decrease in heart rate, respectively. Chronotype was determined by International Ostberg questionnaire (Ostberg test in modification of S.I. Stepanova (Stepanova, 1986).

Hormone concentration in the blood serum was determined by radioimmunoassay with the use of commercial sets. Biochemical parameters were determined using standardized sets by biochemical analyzer.

Statistical data processing was performed using standard statistical software package STATISTICA (StatSoft), USA, version 7.0. Quantitative data are presented as mean (M) and standard error of the mean (m) for a normal distribution of values. Statistical significance of differences was determined by paired Student's t- test for independent samples, the threshold level of statistical significance was accepted at the value of criteria $p<0,05$. Correlation analysis was performed by Pearson method.

Results

The data of comparative examination of the hypertensive patients, who came for treatment at the middle-latitude health resort from the North and from regions with moderate climatic conditions, showed that the number of patients with high degree of comorbidity (81.1%) in the inhabitants of the North significantly exceeded the number of hypertensive patients with similar high comorbidity from the middle latitudes (44.2%).

Analysis of the results shows that in the hypertensive patients at their permanent living in the North the level of comorbidity is 17.2% higher than in the northerners with hypertension who have moved for resort treatment in the middle latitudes (Table 1).

Table 1
Indicators of comorbidity (estimation by CIRS system) and stress in patients with hypertension while living in the North and after moving to the middle latitudes compared with similar patients from middle latitudes

Indices	Hypertension			Significance
	While living in the North	After moving from the North	In the middle latitudes	
	1	2	3	
Comorbidity (points)	29,3±0,7	25,0±0,6	24,6±1,0	p1-2 <0,003 p1-3 <0,001
Cortisol (nmol/l)	606,2±25,6	428,1±11,5	442,0±11,4	p1-2 <0,001 p1-3 <0,001

It was found that the severity of comorbidity in patients with hypertension in the North correlated with an increase in cortisol concentration in the blood (r=0.35).

The data of the Table 1 show that comorbidity level among the northerners, hypertensive patients is connected with the severity of northern stress and is significantly higher than comorbidity level among the inhabitants of the North with hypertension after moving to the middle-latitude health resort.

The degree of stress (by cortisol concentration) in the inhabitants of the North with hypertension, after moving to the health resort, is approaching to the degree of stress in the middle latitude patients. However, the level of psychoemotional stress (21.2±1.1 conv. units) and the degree of desynchronosis (4.9±0.2 points) among the hypertensive patients, who came to the resort from the North, appeared to be higher in comparison with the inhabitants of middle latitudes, patients with hypertension (psychoemotional stress – 18.3±1.2 conv. units; degree of desynchronosis -3.2±0.1 points).

While analyzing the results of the study we found the dependence of comorbidity degree in the northern and the middle-latitude hypertensive patients on the severity of stress manifestations (Table 2).

Table 2
Dependence of comorbidity severity in hypertensive patients who came to the middle-latitude resort from the North and from regions with moderate climate on manifestations of emotional stress, cortisol in the blood and desynchronosis

Indices	Comorbidity in patients with hypertension				P
	Inhabitants of the North		Inhabitants of the middle latitudes		
	low	high	low	high	
	1	2	3	4	
Emotional tension (c.u.)	6,4±0,2	24,7±1,0	15,1±1,8	22,3±1,5	p1-2 < 0,001 p1-3 < 0,001 p3-4 < 0,003
Conflict (point)	0,45±0,02	0,23±0,07	0±0	0±0	p1-2 < 0,003
Fear (point)	1,27±0,08	0,30±0,03	0±0	0±0	p1-2 < 0,001
Psychical discomfort (point)	1,14±0,05	0,67±0,01	0,32±0,03	0,42±0,02	p1-2 < 0,001 p1-3 < 0,001 p2-4 < 0,001 p3-4 < 0,01
Aggression (point)	0,46±0,02	0,36±0,04	0,81±0,07	0,72±0,02	p1-2 < 0,001 p1-3 < 0,001 p2-4 < 0,001
Cortisol (nmol/l)	452,4±16,4	423,6±12,2	435,0±12,6	450,9±20,3	
Desynchronosis (point)	5,9±0,3	4,6±0,4	3,1±0,3	3,4±0,2	p1-2 < 0,01 p1-3 < 0,001 p2-4 < 0,01

Thus, according to Table 2, we can make a conclusion that high level of comorbidity (81.1% of the investigated persons) in the inhabitants of the North in the middle-latitude resort is detected against the background of reliably high psychoemotional stress. However in this group of patients manifestations of negative emotions (conflict, fear, psychical discomfort, aggression) are observed in a much less degree of severity than in the patients – inhabitants of the North with low comorbidity. While in the northerners with hypertension the high comorbidity is combined with lower concentrations of cortisol in the blood and a lower degree of desynchronosis. In the middle-latitude patients with hypertension psychoemotional stress was slightly lower than in the patients in the North. Although the low level of comorbidity was also observed in the group with a significantly lower level of psychoemotional stress. The high level of comorbidity was detected in the middle-latitude patients with more pronounced psychical discomfort and aggression as well as with a slightly higher of stress hormone cortisol concentration and a greater degree of desynchronosis.

As Borisenkov (2010) found, human resistance to stress and desynchronosis in high latitudes depended on a man's belonging to a particular chronotype. These data determined the necessity of study an influence of "morning" or "evening" chronotype on comorbidity severity in the northern and middle-latitude hypertensive patients in the middle-latitude resort.

Our data indicate that comorbidity level in the middle latitude hypertensive patients with "morning" chronotype (26.5±0.2 points) is significantly higher than comorbidity level in the patients with "evening" chronotype (23.0±0.5 points, p<0,001). At the same time, the patients with "morning" chronotype have the lower level of psychoemotional stress (15.7±1.6 points) and cortisol in the blood (422.2±17.1 nmol/l) than the patients with "evening" chronotype (psychoemotional stress – 20.5±0.9 points; cortisol – 458.6±15.0 nmol/l). Northern hypertensive patients, in contrast to middle latitude patients, in case of "morning" chronotype have the level of psychoemotional stress – 10.0±1.3 points and cortisol in the blood – 527.3±22.6 nmol/l; in case of "evening" chronotype - the level of psychoemotional stress – 22.5±1.2 points and cortisol in the blood – 392.7±21.2 nmol/l. That is, different trends of psychoemotional and hormonal reacting of northern hypertensive patients with "morning" and "evening" chronotype to moving in the middle latitudes are revealed.

Despite of decline in psychoemotional stress level when moving of the northerners with "morning" chronotype in the middle latitudes, stress hormone cortisol remains at a high level, indicating the higher severity of stress as compared with the patients of the North with "evening" chronotype. The same people with "morning" chronotype have the greater degree of desynchronosis (6.6±0.2 points) as compared with "evening" chronotype (4.2±0.1 points). The severity of comorbidity in the northern patients with "morning" chronotype (22.6±1.4 points) was less than in the hypertensive patients with "evening" chronotype (25.9±1.5 points).

It should be noted that comorbidity among the inhabitants of the North was in a significant negative correlation with "morning" chronotype ($r=-0.21$, $p<0.05$), while among the inhabitants of middle latitudes this index was less significant but have a positive sign of correlation with "morning" chronotype ($r=0.18$, $p<0.01$). It was also determined that the level of psychoemotional stress in hypertension northerners significantly depended on the severity of comorbidity among the patients with "morning" chronotype ($r=0.48$, $p<0.05$) as well as among the patients with "evening" chronotype ($r=0.45$, $p<0.05$). High dependence of desynchronosis degree in the inhabitants of the North with "evening" chronotype on the severity of comorbidity ($r=-0.57$, $p<0.05$) with a lower dependence of desynchronosis index on comorbidity in patients with "morning" chronotype in the North ($r=-0.39$, $p<0.01$) can tell us about significance of comorbidity in sustaining human resistance to development of desynchronosis in high latitudes. This conclusion is supported by significant dependence of diastolic blood pressure, the adaptive-reduction potential ($r=-0.26$, $p<0.05$), severity of comorbid disadaptive disorders in the northerners from the degree of desynchronosis ($r=0.45$; $r=-0.26$; $r=0.34$, respectively, $p<0.05$).

At the same time, the study has shown that comorbidity in the middle latitude patients with hypertension influences on the severity of desynchronosis to a lesser extent than in the northerners.

Correlation coefficients of comorbidity with degree of desynchronosis in the hypertensive patients from middle latitudes in case of "morning" chronotype ($r=0.37$, $p<0.05$) and in case of "evening" chronotype ($r=0.38$, $p<0.05$) were significant, but less than in similar patients who came from the North.

Discussion

The data presented allow us to conclude that hypertension in non-indigenous inhabitants of the North develops on the background of severe degree of comorbid pathology of the main homeostatic systems of an organism. The high degree of comorbidity in hypertensive patients in the North is found in 81.1 % of the examined patients.

This confirms the conclusions of previous studies in the North about high prevalence of comorbidity in non-indigenous inhabitants of high latitudes, which determines a greater severity of chronic diseases including hypertension as compared with regions with moderate climatic and geographic conditions (Hasnulin, 2012; Hasnulin & Hasnulina, 2013)[6].

It has been found also a clear correlation between the severity of comorbidity in hypertensive patients in the North and the extent of the northern stress, measured by concentration of stress hormone cortisol in the blood. This conclusion is supported by considerable simultaneous reduction of cortisol level and severity of comorbidity in the hypertensive patients after their moving from the North to the middle latitudes.

It should be noted that move from the North reduces concentration of cortisol in the blood nearly to the digits detected in the middle latitude hypertensive patients. The higher level of stress reaction in the northern hypertensive patients is confirmed also by the higher indices of psychoemotional stress and degree of desynchronosis as compared with the middle-latitude hypertensive patients. Attention should be paid to dependence of comorbidity in the hypertensive patients in the North from individual human chronotype. Severity of comorbidity in the "evening" chronotype was considerably greater than in the "morning" chronotype. But the degree of stress reaction (by cortisol) in the northern patients with "evening" chronotype was significantly lower than in the patients with "morning" chronotype. In the patients with "evening" chronotype a significantly lower degree of desynchronosis was revealed compared with the patients with "morning" chronotype.

This higher negative correlation between comorbidity and degree of desynchronosis in the patients with "evening" chronotype in the North shows that the disturb of synchronization of human internal rthythms with external natural rhythms to a large extent depends on individual phenotypic ability (chronopenotype) of a man to engage in a process of human adaptation to the complex of negative environmental factors as maximum homeostatic systems as possible. Prolonged stress functioning of these systems depletes the organ's reserve possibilities and leads in its turn to formation of pathology. Not accidental is that there are correlations between the degree of desynchronosis and the severity of comorbid disadaptive disorders, increase in diastolic blood pressure, decrease in adaptive-reduction potential of an organism.

The data obtained on the severity of comorbidity in the non-indigenous inhabitants of the North with hypertension in comparison with the similar middle latitude patients, the data on the connection between comorbidity manifestation and the northern stress, disadaptive disorders allow us to say that comorbidity in the northern hypertensive patients is, to a large extent, a protective mechanism, providing survival of a man with depleting adaptive reserves under the prolonged northern stress through the mobilization of functions of all complex of life-supporting organs and systems. By Davydovskiy (1969) this process can be called "adaptation of an organism through disease as an altered form of adaptation".

Conclusion

The results of the study confirmed that hypertension in rnon-indigenous inhabitants of the North is accompanied by severe comorbid pathological states and is a consequence of the climatically and geographically caused stress. This is confirmed by the detected relationship of comorbidity in high latitudes with increase in cortisol concentration in the blood, with increase in psychoemotional stress, with a greater degree of desynchronosis in people with "morning" chronotype. In the northern patients it has been shown dependence of diastolic blood pressure increase and adaptive-reduction potential decrease on desynchronosis degree. It has been found greater resistance to desynchronosis in patients with hypertension in the North at high comorbidity.

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