Organization of circadian rhythms of sex hormone secretion in female students with vegetative-vascular dystonia of the hypertensive type involved in fitball gymnastics

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Abstract

Objective of the study was to determine the effect of a course of additional fitball aerobics classes on the circadian rhythms of sex hormones in female students with vegetative-vascular dystonia of the hypertensive type.

Methods and structure of the study. The scientific work was carried out on the basis of the North Caucasus Federal University. Sex hormones in saliva were analyzed using a highly sensitive competitive immunological method. Collections were made at 8.00, 12.00, 16.00, and 20.00 at the beginning of the school year and at the end. Cosinor analysis was carried out using a computer and the Cosinor Ellips 2006 program installed on it. The study involved female students with hypertensive VSD (n=58), female students with hypertensive vegetative-vascular dystonia, and female students with hypertensive vegetative-vascular dystonia who practice fitball. -gymnastics (n=50), and practically healthy female students of the main group (n=50).

Results and conclusions. In female students with vegetative-vascular dystonia of the hypertensive type, engaged in fitball gymnastics, positive changes were revealed in stabilizing the circadian rhythm of estradiol concentration, rhythmostasis of testosterone concentration was still not detected.

Keywords: *vegetative-vascular dystonia of the hypertensive type, sex hormones, estradiol, testosterone, circadian rhythms, cosinor analysis.*

Introduction. Among students involved in physical education in a special medical department, there are still people diagnosed with vegetative-vascular dystonia (VSD), approximately half of which are of the hypertensive type.

In the modern scientific literature there is very little information about the circadian organization of rhythms in young people with vegetative-vascular dystonia. With persistent changes in students with VSD towards sympathicotonia, irreversible pathological changes may occur, in the form of a syndrome of vegetative-vascular-trophic disorders, which will lead to arterial hypertension, which in turn can cause a more unfavorable prognosis for the development of the disease. At the same time, some researchers classify VSD as a disease associated with disruption of the processes of regulation of the body's natural biological rhythms [2, 5], among which the circadian rhythms of the functioning of the body's leading adaptive systems are the most significant [1, 3, 8, 9].

The fact that disturbances in the temporal coordination of body functions are among the first evidence of the development of a pathological process makes studies of changes in biorhythms important in assessing the development of the pathological process, at the initial stage, pre-pathological conditions, diagnosing pre-diseases already present in the body in order to organize preventive measures, and also predicting pathological processes and disease outcome [1, 6, 7]. At the same time, in modern literature there is insufficient information about the influence of sex hormones as the leading link of the hypothalamic-pituitary-gonadal system (HPGS), which, in addition to its main function - the regulation of reproductive pro-

cesses - considers the importance of the HPGG in the body's resistance to environmental factors, which is certainly an important functional task (Milashechkina, Dzhandarova, 2020 ChSM). Based on the characteristics of the chronostructure of the secretion of sexual hormones, it will be possible to predict some complications in certain pathological changes in the body, which is completing its final formation.

Objective of the study was to determine the effect of a course of additional fitball aerobics classes on the circadian rhythms of sex hormones in female students with vegetative-vascular dystonia of the hypertensive type.

Methods and structure of the study. The study involved female students of the main department - control group (n=50), students of a special medical department with hypertensive vegetative-vascular dystonia (n=58), students with hypertensive vegetative-vascular dystonia, engaged in fitball gymnastics (n=50). The concentrations of estradiol and testosterone levels in human salivary plasma were determined using a highly sensitive competitive immunological method. Collections were made at 8.00, 12.00, 16.00, and 20.00 at the beginning of the school year and at the end. To analyze wave processes and process chronobiological data, we used cosinor analysis, proposed in 1965 by F. Halberg (Halberg F., 1965). Cosinor analysis was implemented using a computer and the Cosinor Ellips 2006 program installed on it (Koryagina Yu.V., Nopin S.V., 2006) (Registration Certificate No. 2006611345). The main parameters of the rhythm were studied: mesor (the value of the average level of the sinusoid), the amplitude of the sinusoid, acrophase (the time of the onset of the maximum function). The North Caucasus Federal University acted as the base for the research.

Results of the study and discussion. Cosinor analysis of the secretion of the female sex hormone estradiol at the beginning of the academic year showed that students with vegetative-vascular dystonia of the hypertensive type did not have a circadian rhythm (Figure 1). In the students of the control group, the average acrophase was recorded at 17,04 hours, the mesor was 36,08 pmol/l, the average amplitude was 5,24. At the same time, in female students with vegetative-vascular dystonia of the hypertensive type, the largest average amplitude of fluctuations in estradiol secretion was revealed and amounted to 15,19 pmol/l; an excess of estradiol levels in the evening hours was recorded by 1,8 times (77,61 pmol/l, $p<0,01$), compared to the control group (42,58 pmol/l).

Cosinor analysis showed that circadian rhythms of testosterone were not identified in female students with vegetative-vascular dystonia of the hypertensive type. The average acrophase of testosterone concentration in girls of the control group in the daily rhythm occurs at 9,01 hours, the average amplitude was 0,68 pmol/l, the mesor was 8,05 pmol/l (Figure 1).

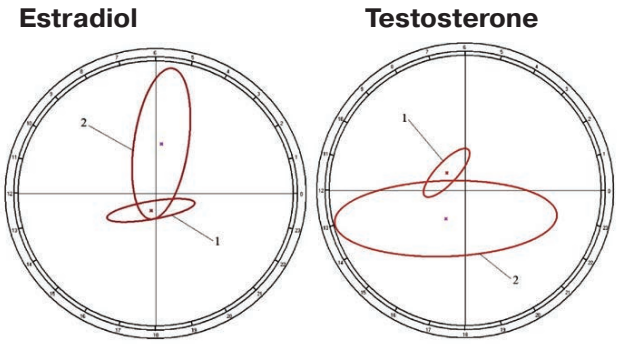

Figure 1. Cosinor analysis of the circadian rhythm of sex hormone secretion in female students with vegetative-vascular dystonia of the hypertensive type

Note: 1 – control group; 3 – VSD of the hypertensive type.

When repeating the cosinor analysis of estradiol secretion, it was revealed that students with vegetative-vascular dystonia of the hypertensive type did not have a circadian rhythm (Figure 2). At the same time, in the morning, the concentration of cortisol is still 1,2 times higher than that of the control group, the maximum value is recorded at 20 o'clock and amounted to 77,61 pmol/l ($p<0,01$), exceeding the control group by 1,8 times.

In female students with a disorder of the autonomic nervous system of the hypertensive type, after a course of fitball gymnastics, the rhythm was determined with an average acrophase of 12,26 hours, an amplitude of 2,16 and a mesor of 47,60 pmol/l. In female students of the control group, the average acrophase of estradiol concentration occurs at 16,30 hours, the amplitude is 4,42 and the mesor is 40,25 pmol/l.

Cosinor analysis of testosterone secretion showed that in girls with vegetative-vascular dystonia of the hypertensive type, as well as in the group doing fitball gymnastics, the circadian rhythm is not defined (Figure 2). At the same time, girls in the control group observed a daily rhythmic organization of T secretion: the average acrophase was 8,09 hours, the mesor was 8,35 pmol/l, the amplitude was 0,71 pmol/l.

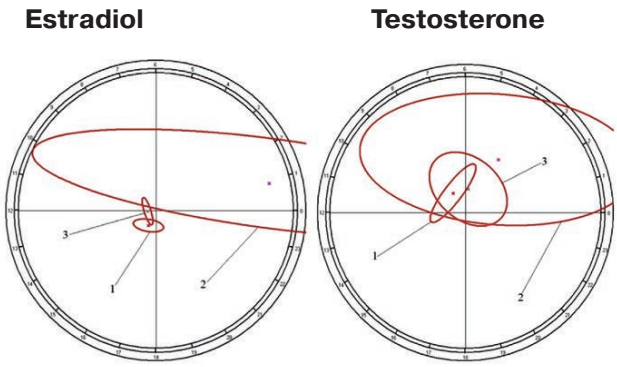

Figure 2. Cosinor analysis of the circadian rhythm of sex hormone secretion in female students with vegetative-vascular dystonia of the hypertensive type, engaged in fitball gymnastics

Note: 1 – control group; 2 – VSD of the hypertensive type; 3 – VSD of the hypertensive type, fitball-gymnastics

Conclusion. In female students with vegetative-vascular dystonia of the hypertensive type, engaged in fitball gymnastics, positive changes were revealed in the stabilization of the circadian rhythm of estradiol concentration; the rhythmostasis of testosterone concentration was still not detected, while a decrease in fluctuations in its amplitude during the day was observed.

References

1. Arushanyan E.B. Sovremennyye predstavleniya o proiskhozhdenii tsirkadiannykh kolebaniy deyatelnosti serdechno-sosudistoy sistemy v norme i pri patologii. Klinicheskaya meditsina. 2012. Vol. 90. No. 4. pp. 11-17.
2. Veyn A.M., Voznesenskaya T.G., Vorobyeva O.V. et al. Vegetativnyye rasstroystva: klinika, diagnostika, lecheniye. Rukovodstvo dlya vrachey. V.L. Golubeva [ed.]. M.: Meditsinskoye informatsionnoye agentstvo publ., 2010. 637 p.
3. Goryachev V.A. Funktsionalnaya kharakteristika khronostruktury serdechno-sosudistoy sistemy v dinamike geneticheski obuslovlennoy arterialnoy gipertenzii. PhD diss. abstract. Moscow, 2015. 22 p.
4. Kurlayeva A., Bryk A., Blagonravov M.L. Klinicheskiye i teoreticheskiye aspekty sovremennoy meditsiny. Proceedings X International scientific conference, Moscow, April 25-27, 2019. Moscow: Rossiyskiy universitet druzhby narodov (RUDN) publ., 2019. 42 p.
5. Milashechkina E.A., Dzhandarova T.I., Rusanova E.I., Mitina E.V. Sutochnaya dinamika kortizola u studentok s somatoformnoy disfunktsiyey vegetativnoy nervnoy sistemy, zanimayushchikhsya fitbol-gimnastikoy. Teoriya i praktika fizicheskoy kultury. 2023. No. 5. pp. 22-24.
6. Molchanova Zh.I., Tatarintsev P.B., Ragozin O.N et al. Khronostruktura ritmov arterialnogo davleniya, kardiotserebralnyye otnosheniya, kognitivnyy status i kachestvo zhizni u bol'nykh rasseyannym sklerozom. O.N. Ragozin, S.M. Chibisov [ed.]. Moscow: Rossiyskiy universitet druzhby narodov (RUDN) publ., 2019. 116 p.
7. Ulashchik V.S. Biologicheskiye ritmy i khronoterapiya. Meditsinskiye novosti. 1996. No. 2. pp. 9-13.
8. Khronobiologiya i khronomeditsina: Rukovodstvo. Guide. S.I. Rapoport [ed.]. M.: OOO «Meditsinskoye informatsionnoye agentstvo» publ., 2012. 480 p.
9. Kurlaeva A. Effect of round-the-clock lighiting on blood pressure, heart rate and secretion of epiphyseal melatonin in normotensive and hypertensive rats. SCIENCE4HEALTH publ., 2019.