PROCEEDINGS OF THE YEREVAN STATE UNIVERSITY

Chemistry and Biology 2018, **52**(2), p. 134–137

Biology

INVESTIGATION OF WRESTLERS' HEART RATE VARIABILITY

M. G. AGHAJANYAN [*], M. R. SARGSYAN [**]

Armenian State University of Physical Culture and Sports, Armenia

In the article the wrestlers' heart rate variability was studied by the method of variational pulsometry. Strain level determination of regulatory systems has certain value for estimating peculiarities of organism adaptation to physical loadings and early detection of overwork and overstrain of athletes.

Keywords: heart rate, variability, regulation, physical loading.

Introduction. Heart rate is not only the indicator of the sinus node function, but also the integral indicator of the system state that provide the body's homeostasis. The change of heart rate is highly correlating with regulatory mechanisms of autonomous nervous system. R.M. Baevskiy has suggested a mathematical analysis method of heart rate, which gives an opportunity to estimate the direction of autonomous tonus and character of sympathetic–parasympathetic ratios [1]. Variational analysis of heart rate gives the possibility of quantitative and differentiated evaluation of the tension or tone degree of the sympathetic and parasympathetic parts of the autonomous nervous system, their interaction in different functional states and the activity of subsystems, controlling the work of various organs [2].

The investigation of conditions of autonomous regulation and definition of regulatory systems tension degree are important to estimate features of organism adaptation to physical loading. It allows to approach the scientific forecasting of sportsmen's physical possibilities that has a significant role in making decision and selecting for sports, rational construction of training regimes and control over sportsmen's functional conditions [3]. Functional testing is an important part of heart rate variability (HRV) investigation, because it allows to judge the adaptive reserves of cardiovascular system [1, 4].

Abovementioned is a base for setting the purpose of actual study: to investigate and estimate the state of wrestlers' autonomous regulations at rest and under physical loading.

Materials and Methods. We investigated 38 freestyle wrestlers at age 17–22. All of them performed an aerobic-anaerobic 6-minute test with dummy throws. During the test ECG study, measurement of blood pressure (BP) and the definition of lactate in blood by G. Strom method were performed. According to that method,

[*] E-mail: amg3746@yahoo.com [**] E-mail: marsar2015@mail.ru

definition was made before physical loading, after it and on the 10th minute of recovery. The study of HRV was carried out using variational pulsometry by R.M. Baevskiy on the basis of an analysis of 100 cardio intervals [5]. The values of the mode (Mo), the variational span (VS), the amplitude of the mode (AMo) and the stress index (SI=AMo / 2VS · Mo), which was calculated with values of Mo, VS and AMo, were determined before loading, after it and on the 10th minute of recovery. In practice, the most significant factor is stress index of regulatory systems, adequately reflecting the total effect of cardiac regulation and characterizing the condition of central contour of regulation.

According to the value of SI alone, athletes were divided into 3 groups: I – 14 people with autonomic balance; II – 10 people with moderate vagotonia; III – 14 people with pronounced vagotonia. Athletes with sympathotonia at rest were not found in our group of subjects.

Results and Discussion. Table presents the SI and BP data before loading, after it and on the 10th minute of recovery.

Data of SI and BP in 6-minute test (M±m)

Groups	Stress index, units			Blood pressure, *mm* Hg					
				BPs	BPd	BPs	BPd	BPs	BPd
	before loading	after loading	the 10th *min* of recovery	before loading		after loading		the 10th *min* of recovery	
Autonomic balance	83.11 ±8.99	667.3* ±58.21	584.87* ±41.58	116.0 ±2.57	74.6 ±2.74	171.45* ±5.82	55.7* ±2.28	121.0 ±3.32	69.2 ±2.21
Moderate vagotonia	36.5 ±2.17	421.58* ±54.1	464.55* ±48.24	115.5 ±3.37	76.5 ±2.11	179.5* ±3.2	63.5* ±3.5	122.5 ±3.43	72.5 ±3.0
Pronounced vagotonia	16.06 ±0.66	570.18* ±56.5	456.38* ±49.9	117.14 ±2.44	72.5 ±1.94	172.14* ±4.15	56.43* ±2.69	121.4 ±2.89	70.71 ±2.71

* – reliability with respect to data before loading.

As follows from the Table, BP values are approximately the same in all groups, with an almost complete recovery of BP on the 10th minute of recovery. Calculation of the mean value of the heart rate before loading, after it and on the 10th minute of recovery indicates a slow recovery (70±1.3, 160±1.9, 102±1.4 bpm respectively).

The value of SI after loading is the highest in the group of autonomic balance and the lowest in the group of moderate vagotonia. On the 10th minute of recovery the highest value of SI is in the group of autonomic balance. The average value of SI exceeds 500 units and is higher than 1000 units among almost half of the sportsmen in this group.

In the group of moderate vagotonia the value of SI continues to grow on the 10th minute of recovery, but it does not exceed 500 units.

In group with pronounced vagotonia the value of SI grows after loading, exceeding 500 units, but it decreases on the 10th minute of recovery.

As a result, SI in all groups is not restoring, remaining within the limits of moderate sympathotonia in vagotonic groups. In the group of autonomic balance, the value of SI remains at the level of pronounced sympathotonia. The received data testifies that all the athletes, especially those having vegetative balance, have signs of fatigue.

It is interesting that comparing the values of SI before loading and after it, the following is revealed: in the group of autonomic balance the SI increases 8 times; in the group of moderate vagotonia increases 11.5 times; in the group of pronounced vagotonia increases 35.5 times. Here it's appropriate to recall the "law of the original level", according to which, the higher the initial level, the more active and stressed the system is [6].

Since SI is sensitive to strengthening of the tone of the sympathetic nervous system, a small loading (physical or emotional) increases it by 1.5–2.0 times, while with significant loading, the growth is 5–10 times. N.A. Aghajanyan [7] surveyed 94 sportsmen of different sports before the competitions and directly at competitions of different levels within an annual cycle. The author showed that there was a significant growth of SI, sometimes by 20–30 times compared with the initial level. And the athletes who won the competition, the indicator reached 4000 or more units. It's also noted that for patients with constant stress of regulatory systems (mental stress, angina pectoris, lack of blood circulation), SI at rest is equal to 400–600 conventional units. Among patients with acute myocardial infarction, SI at rest reaches 1000–1200 units [8].

Thus, we believe that an increase in SI after loading more than 500 units is a fully understandable phenomenon, especially when there is a tendency to reduce SI on the 10^{th} minute of recovery. However, when increased after loading of over 500 units, SI remains on the same height on the 10^{th} minute of recovery, and in some cases SI continues to increase, that indicates overload and over-delayed recovery.

The degree of lactate concentration in the blood also matters. According to our data, the average level of lactate among wrestlers is equal 4.55±0.08 *mm/L* before loading, on the 3^{rd} and 10^{th} minutes of recovery its level is 13.70±1.20 and 11.75±1.22 *mm/L* respectively. According to data from [9], the maximum release of lactate into the blood occurs on the 6^{th} minute after intensive exercise and at the same time the heart rate reaches the maximum too. According to data from [10], maximal concentration of lactic acid in the blood is determined in a wide time frame up to the 10^{th} minute of recovery among different individuals. Perhaps in this regard, it's possible to explain high numbers of SI on the 10^{th} minute of recovery.

Taking in account the concept of R.M. Baevskiy [11] about the two-loop (central and autonomous) regulation models, it should be concluded that central mechanisms of HRV regulations, activating during heavy loadings, continue to dominate during the recovery process, which could be observed among the wrestlers we have studied.

According to R.M. Baevskiy, the cells of the sinus node (self-regulation), the parasympathetic nervous system (vagus nerves and their nuclei in medulla oblongata) belongs to the autonomic regulation contour, and the central contour consists of 3 levels, which correspond not to the anatomical and morphological brain structure, how certain functional systems and control levels are. They are: the level of inner system control through the vasomotor center of the medulla oblongata and sympathetic nervous system; the level of inter-system management (hormone-vegetative homeostasis through hypothalamic-pituitary system); the level of organism's interaction with outer environment (adaptive activity of the organism) through the central nervous system including cortical mechanisms of regulation.

Factually, if additional loadings arise and the autonomous system needs to increase the consumption of resources for performing its functions, then the regulatory mechanism moves to a higher level of regulation.

In conclusion, it should be noted that the preservation of post-loading increase in SI over 500 units on the 10th minute of recovery indicates an overload and super slowed recovery. In this regard, the study of athletes' HRV in the conditions of testing loading will help to identify the threat of fatigue, overtraining and help to correct regulation of training exercises.

Received 11.05.2018

REFERENCES

1. Vegetative Disorders (ed. A.M. Wane). M.: Medical News Agency, 2000, 752 p. (in Russian).
2. **Kulaichev A.P.** Computer Electrophysiology and Functional Diagnostics (ed. 4th). M.: INFRA-M, 2007, p. 370–389 (in Russian).
3. **Shilovich L.L.** Perspectives of Diagnostic Application of the Heart Rate Variability Analysis Method in Sports. // Problems of Health and Ecology, 2012, v. 3, № 33, p. 60–63 (in Russian).
4. **Mikhailov V.M.** Heart Rhythm Variability. Experience of Practical Using Method. Ivanovo, 2000, 200 p. (in Russian). **Baevskiy R.M., Kirillov O.I., Kleckin S.Z.** Mathematical Analysis of Heart Rate Changes under Stress. M.: Nauka, 1984, 221 p. (in Russian).
5. **Baevskiy R.M., Kirillov O.I., Kleckin S.Z.** Mathematical Analysis of Heart Rate Changes under Stress. M.: Nauka, 1984, 221 p. (in Russian).
6. **Wane A.M., Solovyova A.D.** Limbiko-Reticular Complex and Vegetative Regulation. M.: Nauka, 1973, 266 p. (in Russian).
7. **Aghajanyan N.A., Batotsyrenova T.E., Semenov Y.N.** Competitive Stress among Representatives of Various Sports on the Parameters of Heart Rate Variability. // Theory and Practice of Physical Culture, 2006, № 1, p. 2–5 (in Russian).
8. **Snejitskiy V.A.** Methodological Aspects of the Heart Rate Variability Analysis in Clinical Practice. // Medical News, 2004, № 9, p. 37–43 (in Russian).
9. **Gavrilova E.A.** Rhythmocardiography in Sports. SPb: Publishing House of the State Medical University named after I.I. Mechnikov, 2014, 164 p. (in Russian).
10. **Kharitonova L.G.** Types of Adaptation in Sport. Abstract of Doctoral Thesis. Omsk, 1991, 206 p. (in Russian).
11. **Baevskiy R.M., Berseneva A.P.** Evaluation of Adaptive Capabilities of the Organism and the Risk of Developing Diseases. M.: Meditsina, 1997, 265 p. (in Russian).