Determinacy of pre-competitive heart rate regulation processes by personal characteristics of athletes

Belova Evgenia Lyudvigovna
Associate Professor, Department of Physical Culture, Sports and Adaptive Physical Education, Institute of Pedagogics, Psychology and Physical Education
Vologda State University
Vologda, Russia
lab_ffk@mail.ru
0000-0001-6980-7070

Rumiantseva Natalia Valerievna
Associate Professor, Department of Physical Culture, Sports and Adaptive Physical Education, Institute of Pedagogics, Psychology and Physical Education
Vologda State University
Vologda, Russia
nyrum_skirur@mail.ru
0000-003-2871-899X

Melentieva Natalia Nikolaevna
Associate Professor, Department of Physical Culture, Sports and Adaptive Physical Education, Institute of Pedagogics, Psychology and Physical Education
Vologda State University
Vologda, Russia
nataliyamelenteva@mail.ru
0000-0002-7415-7380

Abstract. The purpose of the article is to study the features of heart rate regulation in the pre-competitive period, depending on personal characteristics. Materials and methods: qualified and highly qualified athletes of various specializations (n = 50) participated in the study. The parameters of autonomic regulation were evaluated using the method of heart rate variability (HRV), carried out under pre-competitive stress conditions before city, regional and national competitions. The experiment was conducted according to the following scheme: the first measurement - recording HRV and personal characteristics on the day of rest (relative physiological rest), the second measurement - one hour before competitions (stress). The personal characteristics of the athletes were determined using the 16PF Cattell’s questionnaire (form C) and the Spielberger’s Test Anxiety Inventory. Results: the paper shows two types of HRV variability [4, 9, 13]. This method reflects the adaptive reaction of the whole organism based on the study of the relationships of three regulatory units: neurohumoral regulation of the heart, sympathetic and parasympathetic tone of the autonomic nervous system, which change their activity under stressful conditions [1, 6, 11]. This study is aimed at establishing the features of heart rate regulation in the pre-competitive period, depending on personal characteristics,

II. MATERIALS AND METHODS

Qualified and highly qualified athletes of various specializations (n = 50) participated in the study. The parameters of autonomic regulation were evaluated using the method of heart rate variability under conditions of pre-competitive stress before city, regional and national competitions. The personal characteristics of the athletes were determined using the 16PF Cattell’s questionnaire (form C) and the Spielberger’s Test Anxiety Inventory.

The experiment was conducted according to the following scheme: the first measurement - recording HRV and personal characteristics at relative physiological rest on the day of rest (rest), the second measurement - one hour before competitions (stress).

Statistical data processing was performed in the Statistica 6.0. software.

III. RESULTS AND DISCUSSION

In response to stress, adaptive systemic responses occur that are compensatory in nature. Analyzing the results obtained, significant changes in the parameters of heart rate in the pre-competitive period were found. All recorded cases of adaptive responses were divided into two groups (I and II) with an antagonistic change in a number of parameters (Table 1).
The reaction of group I (n = 24) consisted in an increase of the LF component increased (p≤0.05). The reaction of group II (n = 26), these indicators changed oppositely. Such index (SI) changed in the opposite direction. In athletes of group I, the regulatory processes adequacy index (IVB), the balance (VB), the CV%, the RMSSD, the SDNN, the RPAI, the HF, the TP, the VRI, the HR, the BP, the TP, the ms²2, the VLF, the ms²2, the LF, the ms²2, the HF, the ms²2, the 2412±69, 3084±87, 7391±2209, 5. were revealed for any of the factors in the personality questionnaire (p>0.05).

To reveal the features of the responses of autonomic regulation to cardiac activity in the pre-competitive period, a correlation analysis was performed between HRV indicators, personal characteristics of athletes and characteristics of the psycho-emotional status of those registered in the pre-competitive period in a clinostatic position. It has been established that in the formation of an autonomic profile in the pre-competitive period, personal characteristics related to the emotional-volitional and communicative block are involved. No reliable relationships with factors of the intellectual block were revealed (p>0.05).

The P-factor (prudence - impulsivity) has a negative relationship with indicators: RRNN (r = -0.32 at p <0.05), SDNN (r = -0.34 at p <0.05), pNN50% (r = -0.38 at p <0.01), TP (r = -0.32 at p <0.05), VLF (r = -0.29 at p <0.05), HF (r = -0.32 at p <0.05), Mo (r = -0.42 at p <0.01), VB (r = -0.31 at p <0.05). Positive relationships for this factor were revealed with HR (r = 0.32 at p <0.05), AMo (r = 0.33 at p <0.05), IVB (r = 0.34 at p <0.05), RPAI (r = 0.38 at p <0.01), VRI (r = 0.41 at p <0.015), SI (r = 0.38 at p <0.01). The obtained relationships suggest that athletes characterized by emotionality, impulsivity, cheerfulness, talkativeness and a high number of points on the P-scale demonstrate a tendency to increased sympathetic tone in the regulation of cardiac activity before competitions. On the contrary, an increase in volitional control of emotions was associated with an increase in parasympathetic influences.

The C-factor (emotionally stable - reactive) is characterized by the correlations with the following parameters: LFnorm (r = 0.35 at p <0.05), LF / HF (r = 0.35
The personal characteristics of athletes take part in the features of the response of autonomic regulation to cardiac activity before competitions.

Athletes responding to competitive stress by an overactive adaptive reaction (group I) are characterized by volitional control of emotions, fatigue, a tendency to emotional lability, irritability, dependence on others, anxiety, timidity, and sensitivity to threats. On the contrary, athletes who adequately respond to pre-competitive stress (group II) are characterized by emotionality, impulsiveness, cheerfulness, talkativeness, emotional maturity, independence, self-confidence, an active lifestyle and a realistic attitude to the current situation.

REFERENCES


The data obtained indicates an increased reactivity of the sympathetic nervous system before competitions in emotionally mature and realistic-minded persons. Fatigable, emotionally labile, irritable persons tend to respond to competitive stress by increasing parasympathetic tone.

The relationship between the E-factor (accommodation-independence) and the following indicators was established: HR (r = 0.32 at p <0.05), RPAI (r = 0.29 at p <0.05), RRNN (r = -0.36 at p <0.05), MF (r = -0.43 at p <0.01), RRNN (r = -0.35 at p <0.05), %HF (r = 0.35 at p <0.05), HFnorm (r = 0.29 at p <0.05), LF/HF (r = 0.59 at p <0.05), %HF (r = -0.35 at p <0.05). The data obtained indicates an increased reactivity of the sympathetic nervous system before competitions in emotionally mature and realistic-minded persons. Fatigable, emotionally labile, irritable persons tend to respond to competitive stress by increasing parasympathetic tone.

The correlations revealed indicate that more active, courageous athletes sensitive to changes in the current situation, have a stronger tone of sympathetic activity before competitions. Athletes who are timider, prefer to be in the shade, are characterized by increased sense of threat and increase in the tone of parasympathetic activity in response to orthostatic test before competitions.

The Q2 factor (self-reliant – rule-conscious) had a relationship with the parameters: LF/HF (r = 0.29 at p <0.05), LF / HF (r = 0.29 at p <0.05), HFnorm (r = 0.29 at p <0.05). More mature, responsible athletes are characterized by an increase in the tone of the sympathetic system, on the contrary, unorganized individuals are prone to increased parasympathetic influences.

The O-factor (self-assured - apprehensive) correlated with LF (r = -0.31 at p <0.05). The Q4 factor (relaxed-tense) correlated with APsed (r = -0.29 at p <0.05). In people with increased anxiety, sympathetic activity decreases in response to competitive stress.

The Q2 factor (self-reliant – group-oriented) had correlations with HR (r = 0.31 at p <0.05) and RRNN (r = -0.32 at p <0.05).

The study of psycho-emotional status revealed moderate personal anxiety in 77.6% of the athletes from the sample and situational anxiety - in 34.7%; 22.4% and 51% of athletes showed a high level of personal and situational anxiety, respectively, and 14.3% of the athletes in the sample showed low situational anxiety. The indicator of situational anxiety correlates with the following parameters: RRNN (r = 0.34 at p <0.05), Mo (r = 0.38 at p <0.01), VB (r = 0.33 at p <0.05), HR (r = -0.35 at p <0.05), RPAI (r = -0.37 at p <0.01). It can be concluded that athletes with increased situational anxiety before competitions show a tendency to vagotonia, athletes with lower values of situational anxiety tend to be sympathetic. We attribute the obtained data to a compensatory increase in the activity of the parasympathetic system in response to the activation of its sympathetic link as a result of stress exposure. Some authors see this mechanism as a phenomenon of “protective inhibition” that occurs in subjects with strong mental stress [10].