Functional state of athletes during testing loads

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Abstract: Testing loads use for functional state determination and functional abilities of athletes' organism revelation is necessary in order to improve the quality of educational-training process and to achieve high sports results. **Materials.** Testing loads of different physiological orientation and power revelation for athletes' functional state determination. **Research methods.** Information sources analysis and summarizing, tetrapolar chest rheography method according to W.G. Kubicek with other authors, testing, mathematical statistics method. **Results.** The held research showed that in terms of active body position change the whole complex of cardiorespiratory system indices takes part in compensatory-adaptive reactions of athletes' organisms. Among them it is impossible to define the leading factor in organism adaptation. That is why the importance of the offered physical load is leveled by the received research results. They prove low importance of this load. The last two loads use for the peculiarities revelation in the activity of athletes' organism gains important scientific-practical meaning as an additional factor of control over athletes' functional state and the changes introduction into the regimen of the training lessons. During the functional state determination it is reasonable to take into account the testing loads of dynamic character. In this case their individual characteristics are revealed. They are connected with adaptive relations between the components of cardiorespiratory system and demonstrated in different variants of reaction. They depend on age-related peculiarities, kinds of sport and the power of the used physical loads. **Conclusion.** Testing loads meaning revelation for their further use would provide correct educational-training process organization. **Keywords:** testing physical loads, work capacity, bicycle ergometer, functional state.

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INTRODUCTION

P.K. Anokhin offered to consider the activity of a person from the position of physiology and psychology in terms of an integral functional architecture. He took into account functional system as "a closed physiological education with constant back information concerning the success of such adaptive action" [1]. In his opinion, functional state is a difficult system reaction. It changes dynamically during activity and is the result of interaction between functional systems of a person's

organism. It means that functional state should be considered as the result of an organism dynamic interaction with environment. It reflects the state of "the organized unit". Nowadays functional state is a functional background or factor. It conditions a person's behavior, his abilities (including labor and connected with physical exercises fulfillment). It reflects the characteristics of regulating processes in a norm and pathology [2,3]. In this case we consider background activity in terms of which the activity is realized.

Different testing loads use, which model different sides of environment, is one of the principles formed at the beginning of the last century by I.P. Pavlov (1999) [4]. With their help information can be received concerning objective characteristics of an organism functional state [5]. Such kind of test can be body position change in space. It is natural, not connected with any additional efforts use, functional test. It is the model of everyday loads of a person and the result of vegetative regulation. Taking this into consideration in order to get valid estimation of cardiovascular system adaptive abilities, as the part of cardiorespiratory system, different tests are used with body position change. Moreover, in medical and biological research works motor activities are widely spread. They have high level of diagnostic value. In this case generally adopted and preferable is considered bicycle ergometry, owing to which there appears the opportunity to get physiological information during the activity itself [6].

The aim of the research is to reveal the testing loads of different physiological orientation and power for functional state of athletes' organism determination.

MATERIALS AND METHODS

In terms of an active body position change we examined the group of male athletes at the age of 22-26 (20 people). The average body length was 175,45 cm, the average weight - 73,90 kg. All respondents had orthostatic steadiness and during the first minute in lying, standing and sitting position using tetrapolar chest rheography method by W.G. Kubicek and other authors (1966) we registered their differential rheography and ECG in order to determine cardiac stroke volume and heart rate [11-13]. 108 male athletes at the age of 18-53 (who go in for different kinds of sport and who have sports qualification of master of sport till the second category) took part in the work at bicycle ergometer with the increasing power till 200W. Also the group of male athletes (12 people) at the age of 19-44, who have high total body sizes, was examined.

In medical-biological research works the testing loads were applied [7,8,9,10]. Natural, not connected with some additional efforts use, active

body position in space (active orthostasis). It is the result of vegetative regulation and the work at bicycle ergometer of gradually increasing power with precise dose of physical load. Owing to it there is the opportunity to get physiological information during motor activity itself. All these testing loads are widely used in examination of athletes during physiological mechanisms of adaptation study and in order to change educational-training process for high sports results achievement in a chosen kind of sport [8,9].

RESULTS AND DISCUSSION

The most available testing load is an active change of body position or an active orthostatic test, used for shifts in cardiovascular system revelation and for control over rehabilitation processes in an athlete's organism. In order to reveal the shifts during the initial period of an active body position change we used orthostatic test. As a result it was stated that during the transfer from the lying position into standing position, which was called partial orthostasis, during the first minute after body position change blood minute volume changed for a valid volume (table 1). During the first 10 seconds it was connected with cardiac stroke volume (CSV) and HR and at the end of the first minute with the shift only in heart rates. In this connection we define two phases of compensatory reactions of cardiac output. The first phase- duration since the beginning of the research till 10 seconds. It is characterized by defined tachycardia and CSV decrease.

The second phase (50-60 seconds) is in stabilization of stroke output and heart rates decrease. All this was reflected in a wave-like character of MBV change.

During the transfer to standing position changes in cardiac output volume are connected only with valid shifts in CSV index, and chronotropic reaction of heart is not the main in MBV support. In this case we can define two phases of compensatory shifts: the first (0-10 s) is defined by valid chronotropic reaction of heart increase and steady CSV, the second (50-60 s)- contrary phenomena. During the first seconds of body position change the initial effects appear and later secondary,

compensatory ones, directed toward the initial changes of blood circulation evasion and toward circulatory homeostasis preservation.

Activity at bicycle ergometer of gradually increasing power till 200W led to one of cardiorespiratory system reactions demonstration: inotropic, chronotropic, respiratory or mixed (chronotropic-respiratory, inotropic-respiratory) (table 2). The most optimal reaction from these

reactions is connected with inotropic function of heart increase. It can provide physical working capacity increase and sports results owing to functional reserve of blood circulation and respiratory systems increase. The load of 3 W/kg, which we defined as maximal power loads, provided the mixed type of reaction revelation: chronotropic-respiratory; inotropic-respiratory (table 3). It proves additional mechanisms connected with oxygen provision during motor activity.

Table 1 – Heart activity indices in the group of athletes during the initial period of an active body position change

Indices	The position of the respondent				
	Lying	Sitting		Standing	
		0-10 s	50-60 s	0-10 s	50-60 s
CSV, ml	109.84 [*]	93.93 [*]	91.77	91.43 ⁰	77.37 ⁰
	3.34	3.65	3.88	3.17	3.04
HR, beats/min	67.84 [*]	86.97 ^{*+}	74.74 ^{+X}	87.80 ^X	85.85
	2.04	2.45	2.63	2.18	2.82
MBV, l/min	7.39 [*]	8.30 ^{*+}	6.81 ^{+X}	8.13 ^{X0}	6.16 ⁰
	0.47	0.39	0.33	0.46	0.32

Notes. *, +, X, 0 – statistical validity of differences between one and the same indices, but in terms of different body positions and time periods

Table 2 – Types of cardiorespiratory system reaction in the groups of athletes during bicycle ergometric load of 200 W power

Type of reaction	Indices		
	HR, beats/min	CSV, ml	RMV(respiratory minute volume), l
Inotropic	141.83±	147.53±	58.511.16
Chronotropic	169.34±	103.96±	63.04±
Respiratory	149.42±	112.11±	78.71±
Chronotropic - respiratory (HR – RMV)	173.62±	111.88±	84.35±
Inotropic - respiratory (CSV – RMV)	146.74±	144.75±	86.83±

Table 3 – Types of cardiorespiratory system reaction in groups of athletes during bicycle ergometric load of 3 W/kg power

Type of reaction	Indices		
	HR, beats/min	CSV, ml	RMV, l/min
Inotropic	146.34±4.15	135.29±3.93	60.37±2.06
Respiratory	157.89±5.61	119.55±3.27	85.63±3.17
Chronotropic - respiratory (HR – RMV)	171.46 ±	107. 67 ±	84.60 ±
Chronotropic - inotropic - respiratory (HR – CSV – RMV)	184.09 ±	149.70 5.02 CV = 7.51 %	95.76 2.48 CV = 5.81 %

CONCLUSION

The held research showed that during an active body position change, which we define as minimal physical load, the whole complex of cardiorespiratory system indices takes part in compensatory-adaptive reactions of athletes' organism and the leading factor can't be defined among them. That is why the importance of the offered physical load is leveled by the received research results. They prove low importance of this load. The last two loads use for the peculiarities revelation in the activity of athletes' organism gains important scientific-practical meaning as an additional factor of control over athletes' functional state and the changes introduction into the regimen of the training lessons. During the functional state determination it is reasonable to take into account the testing loads of dynamic character. In this case their individual characteristics are revealed. They are connected with adaptive relations between the components of cardiorespiratory system and demonstrated in different variants of reaction. They depend on age-related peculiarities, kinds of sport and the power of the used physical loads. Thus, testing loads meaning revelation for their further use would provide correct educational-training process organization.

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