PEDAGOGICAL CONTROL OF STUDENTS' PHYSICAL STATE BY RESEARCH RESULTS OF CARDIOVASCULAR SYSTEM'S FUNCTIONAL INDICATORS

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Abstract. The questions of estimation of bodily condition of students are considered on the basis of study of functional indexes cardiovascular system. 15 students took part in an experiment. The followings parameters were determined: frequency of heart-throbs, arteriotony, shock volume of circulation of blood. Frequency of heart-throbs was registered on electrocardiograph in the second standard taking. Results were processed through the method of variation measurings of pulse Parina - Baevskogo. It is set that at all of examinee the chart of return reaction on the offered loading on every index has S - vivid form, but with the different steepness of charts of return reaction. It is found out that participation of parameters on an irritant at an examinee differently. For one students it shows up in form frequency characteristicness, at other - on a volume. The account of these features allows objectively enough to judge about current functional status cardiovascular system.
Keywords: bodily condition, cardiovascular system, students, prophylaxis.

Introduction

Insufficient motion activity and mental overstrain are typical for students [2, 10, 15]. This conditions the demand of thorough pedagogical and medical control of every student's physical state. Such control will increase the efficiency of disease preventive means and the quality of future specialists' training.

There is a number of unsolved problems in studying of man's physical state with the help of means and methods of pedagogical control [1, 2, 16]. The solution of these problems is connected with certain difficulties. The main of them is the abundance of methods and parameters of physical state diagnostics, which hinders the practical aspect of researches.

In sports physiology three physiological systems: cardiac vascular system (CVS), respiratory and nervous muscular ones are considered for evaluation of students' physical state.

In studying of cardiac vascular system (CVS) the cardiac beat frequency (CBF) is considered the most labile indicator of circulatory system. This indicator changes under quite different influences – emotions, physical and chemical environmental factors, diseases, muscular activity, etc. With that, CBF is one of the most available for control: from the widespread for long time palpation to different electrocardiography methods, telemetry inclusive. Basing on this method it was stated that CBF of skilled sportsmen with high robustness (track and field athletes, swimmers, skiers) in rest is of 40 – 50 beats per minute. For more overall evaluation of cardiac vascular state the indicators of arterial pressure (AP) are used. In some research works, the AP indicators are given as reduced (50/170), the other authors do not find not this phenomenon [8, 12]. There are some observations which state that the development of physical state is accompanied by increasing of blood pressure instead of decreasing [5].

For laboratory research precise recording equipment like mechanical cardiograph by Savitskiy N.N. and different oscillograph and tachyooscillograph attachments with multi-channel recording equipment are used. For mass AP testing the traditional Korotkov's method of AP examinations is most frequently used.

In sports medicine hemodynamics indicators (stroke volume and cardiac output, vascular resistance and blood velocity) are used for more overall evaluation of CVS functional state [4, 7, 13, 14].

The present researches have been executed in accordance with the plan of scientific research work of National university "Legal academy of Ukraine named after Yaroslav the Wise".

Purpose, tasks, materials and methods.

The purpose of the research is to evaluate the students' physical state on the base of studying of cardiac system functional state indicators.

The research (of Legal academy of Ukraine students) had been carried out from September 2011 to May 2012. 15 persons took part in experiments.

Cardiac vascular system was examined with the help of determination of the following parameters: cardiac beat frequency, arterial pressure, stroke volume of circulation.

Cardiac beat frequency was recorded by electrocardiograph in the second standard leads. The results were processed with the help of Parin – Bayevskiy's variation pulse metering method for plotting of variation pulsegram. The essence of this method is estimation of distribution of the most frequently met frequencies of cardiac beat. For this purpose one hundred of ECG cycles were recorded and the cardiac beat frequency was determined by the distance between peaks R – R. The obtained values were plotted on the graph in the reference system: X- axis –frequency of cardiac beat, Y-axis – the number of beats with the given frequency. The evaluation of current state was carried out by the shape of the obtained distribution.. The skewness of distribution shows that the processes of fatigue or restoration dominate and it permits to judge if further physical load is possible. These examinations were carried out with one and the same student in different states (in rest, under load and etc.) All diagrams of every tested student were plotted on

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one graph. This made possible to estimate the variation of most frequently repeated frequencies depending on the load, and to obtain general characteristics of skewness's distribution for different functional states.

AP examinations were carried out with the help of automatic tonometer aimed for measuring of systolic and diastolic blood pressure by Korotkov's method.

Hemodynamic parameters were recorded by means of rheography with the help of tetrapolar, two way rheoplethysmograph РПГ2 – 02.

The examinations of CVS functional state were carried out with one and the same student in different states (in rest, i.e. without load and under load). The following loads were used:

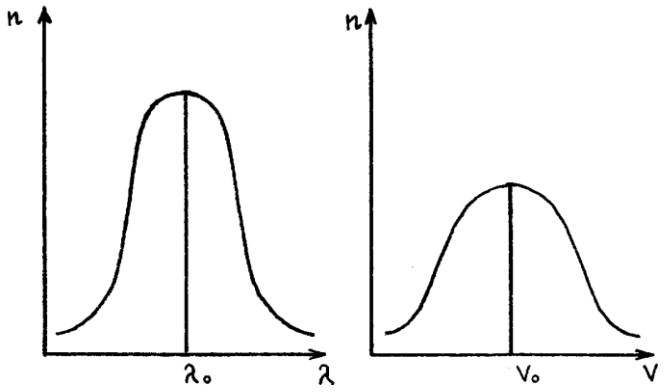
1) "Rebreathing" in the system "bag in box" with accumulation of CO 2 (O2 content in the bag within 30-50%). The creation of progressive "pure" hypercapnic stimulation was ensured during 5 - 6 minutes;

2) "Rebreathing" in the same system with permanent decreasing of O2 content from the atmospheric level in the bag from the atmospheric level. Equalization of PaCO2 by CO_2 absorption system was ensured, i.e. the progressive isocapnic stimulation was created for 6 – 7 minutes.

3) "Rebreathing" in system "from bag to bag" [3, 6, 11].

The results of researches

As far as the circulatory function of CVS is conditioned not only by its frequency response we made an attempt to find an interconnection between the changes of cardiac beat frequency (CBF) and stroke volume (SV) in different states of the tested students' organisms (before, during and after loads). Breathing in closed space of big volume and breathing from vessel with standard gas mixture [3] were used as loads. The choice of these loads was conditioned by the fact that the increasing of CO2 concentration in exhaled air at every step of breathing in system "from bag to bag" corresponds to steady states, which were compared each with other [11]. The analysis of the obtained results of CVS examinations permitted to find that CBF and SV indicators comply with normal law of distribution (Fig.1).

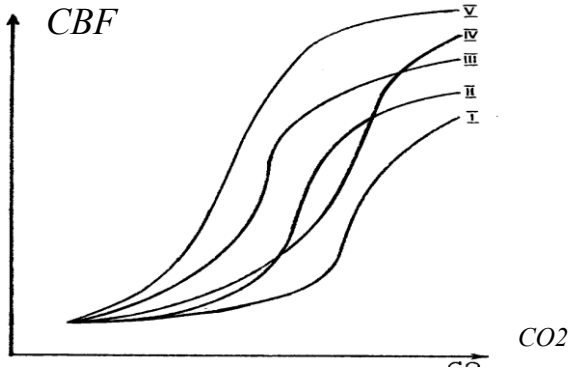


λ – CBF; V – SV

Fig.1. Diagram of CBF and SV indicators' normal distribution.

As a result we observe complete adequacy of Parin – Bayevskiy's method concerning these characteristics of CVS with their being measured in different states of the tested student.

If to create different steady states (like it was done in the example of step-by step rebreathing) and observe the changes of CVS frequency and volume responses to one and the same irritant (CO2), it can be noted that CBF and SV of every tested student have strongly individual characteristics. The difference between these responses lies, first of all, in the fact that all tested students show different speed of answer to irritant. This difference was especially expressed when plotting diagrams of response of the studied CV indices (Fig.2).



I – V – numbers of the tested

Fig.2. Diagrams of the tested students' CBF response to increase of CO2%.

From the given material it is clear that the increasing of frequency heart rate and stroke volume takes place unevenly that is expressed by the different slopes of these curves. With this on every curve there are peculiar "sites" which characterize steady states for their stage of load. The analysis of the results showed that with one and the same value of irritant the curve of CBF response of tested student No.5 is steeper than of tested student No.1. Probably, it occurs as a result of different adaptation "value" by CVS frequency response of the mentioned individuals.

Besides, it should be noted that with every subsequent transition to new state the transition phase becomes less and the dispersion of control indicators of the tested students restricts (Fig. 3).

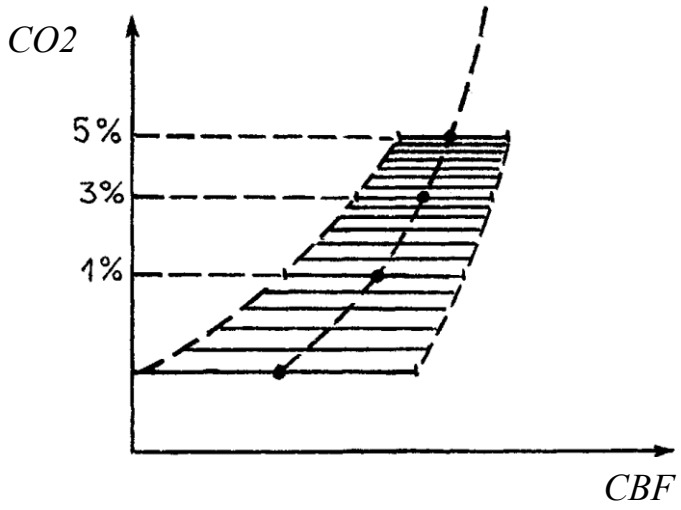


Fig. 3. Dispersion of CBF indicators as the response to the increasing of CO2%

In order to determine the connections between CBF and SV indicators the comparison of them was made. The successive combination of these characteristics shaped a domain of their dispersion in every steady state.

See fig.4.

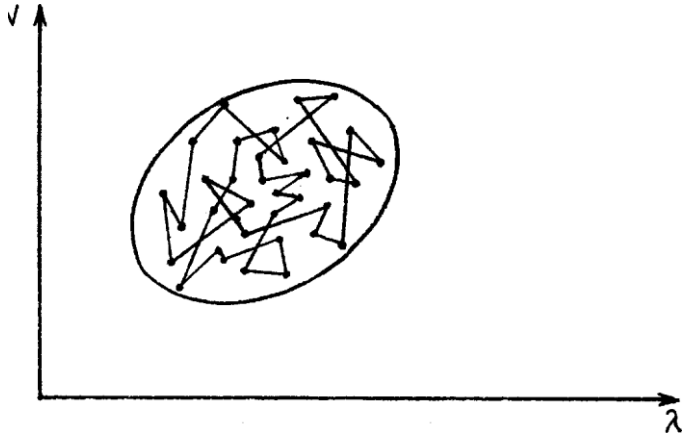


Fig.4. Domain of combinations dispersion of CBF and SV indicators in steady state.

If to compare the combinations dispersion domains of CBF and SV indicators in different steady states we obtain the domain of possible states for every tested student. (See fig. 5). On this figure we see the tapering of the parameters dispersion domain with increasing of irritant strength. Besides, it should be noted that different tested students display different response of CVS control indicators to one and the same irritant. For example: the CVS response of tested student No.1 to load is expressed mainly in frequency characteristics, in case of tested student No. 3 it is expressed by the volume characteristics. The most typical determination of CVS indicators aptitude is observed under more strong irritants.

Such method of reflection of the obtained information permits both: to quantitatively estimate the level of the system's activity and to find the individual peculiarities of its participation in response to irritant, which consist of clearly expressed uneven manifestation of the response form by some tested students, either in frequency characteristics or in volume one. This makes possible to suggest that under equal impact of environment, the persons with aptitude to manifestation of definite response will develop the appropriate adaptation mechanisms.

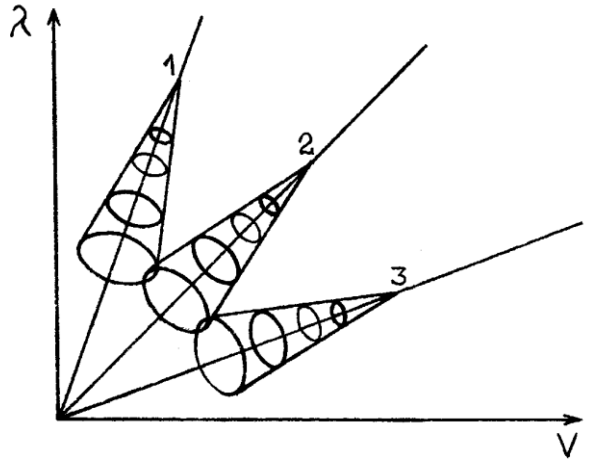


Fig. 5. Domains of combinations dispersion of CBF and SV indicators in different steady states

Summary

The results of research of cardiac vascular system's functional state showed that in CVS characteristics, which are most frequently used in physical culture and sports practice, hemodynamics indicators are more notable [4, 7]. That is why in the present paper the dynamics of its most typical parameters: CBF, SV and AP under different loads were studied.

The following was found with the help of the obtained results. For all tested students the diagrams of response to load have "S" shape by every CVS parameter. With this, different tested displayed individual unequal steepness of response diagrams. It is connected with the fact that individuals transfer from one state to other with different speed and it confirms the authors' opinion [5, 6, 9, 12] about unequal "value" of CVS adaptation parameters. Thus, for some tested CBF response diagram was steeper than SV one, for the other tested the picture was quite different. It permits to judge about different participation of the studied characteristics in response to load.

When comparing the results of CVS frequency and volume characteristics studies the domains of these combinations dispersion were plotted. The comparison of the domains, obtained from different persons, resulted in discovering their different location. In diagrams of some individuals it is located nearer to CBF axis, in the diagrams of others it was nearer to SV axis. It permits to conclude that CVS of some students responds by its frequency characteristics and CVS of the others responds by volume one. Determination of this peculiar participation of different CBF indicators in response to load gives possibility to reveal the aptitude to different forms of disturbance in this system's activity [6, 9].

More objective method of control over current physical state can be determined in the course of further research of respiratory and nerve - muscular system functional state for discovering general regularities of different parameters responding to loads.

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