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CHANGES IN THE INDICATORS OF CARDIAC PUMPING FUNCTION OF PARACHUTISTS BEFORE JUMPING AND AFTER LANDING

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Abstract.

Studying the reaction of the cardiac pumping function of the parachutists at various stages of preparation for jump, we found that, as the athletes develop their skills, the difference between the values of heart rate prior to and after landing decreases significantly. At the same time, the least difference in heart rate values prior to and after landing was recorded in the masters of sports of international class. While the athletes of participation classes and masters of sports have this difference maintained at a high level of nearly 69-70 bpm ($P < 0.05$). The maximum difference in heart rate values prior to and after landing was recorded in ex-masters of sports. As the parachutists upgrade their level of fitness, the stroke volume response, on the contrary, increases. However, we detected a negative stroke volume response for the first time in both the beginners and the ex-masters of sports after the jump.

Keywords: heart rate, stroke volume, parachutists, sportsmen of various classes.

Introduction.

The most popular types of sports among young people in recent years are the extreme sports. At the same time, parachuting has become the most popular in recent years in Russia and in the Republic of Tatarstan. Parachuting engages a significant number of young people (high school age children, students and adults). It should be noted that the parachute sport specifies specific requirements for the sportsmen. Parachutists are usually not subject to any heavy muscular exercise. During the training, they do not perform heavy exercise, as in the case of other types of cyclic and acyclic sports. However, in preparation for the jump (starting from packing the parachute and ending with boarding on an aircraft), during the performance of the jump (when the human body experiences large positive overload in the process of free fall) and at landing, the sportsmen's body undergoes significant changes. Parachuting also requires to have certain psychological abilities. Parachuting has a different specificity as compared to the "land" sports [2]. The main difference is in the impact of stress factors on the parachutist's body during jump, such as

atmospheric pressure drops, acceleration, overload, motion sickness, etc. This type of sport imposes significant, specific requirements for the growing organism. According to researchers, the long-term sports activity causes significant changes in the activities of the various organs and systems [1,3]. At the same time, particular changes in the parameters of cardiac pumping function of the growing organism during regular parachuting training remain insufficiently studied.

Objective of this research was to study the indicators of heart rate and stroke volume of youth going in regularly for parachuting sport.

Our experiments were conducted at the airport "Kurkachi", located in the Republic of Tatarstan near Kazan. The studies involved athletes ranging from beginners to the masters of sports of international class. The beginners were young men participating in military field training at the paratroop club. This field training are held annually within the framework of military-patriotic work and organized by the Ministry of Youth, Sports and Tourism of the Republic of Tatarstan and the Republican sports and patriotic center "Patriot" together with the Russian Defence Sports and Techniques Organization (ROSTO) (Voluntary Association for Assistance to Army, Air Force and Navy) of the Republic of Tatarstan. These guys had little experience of jumping with a parachute.

The competitive sportsmen, masters of sports and masters of sports of international class were the athletes participating in competitions in parachute jumping in the Russian championship.

One more group of people was examined. This group included the former masters of sports in parachuting at the age of 40-45 years, i.e. veterans of parachuting. This group was composed of people pursuing an active lifestyle without bad habits and having no jumps with a parachute approximately for 10-15 years after the end of their sports career.

Heart rate (HR) and stroke volume (SV) were recorded on the day of jumps, i.e., in the morning, immediately after getting up. And then these indicators were recorded before the jump, i.e. immediately prior to boarding on the aircraft and immediately after landing. Rheogram registration in all three studies was performed in the supine position. Both HR and SV were determined by tetrapolar chest rheography [4].

Results and discussion

According to our research, the 16-17-year-old adolescents without experience in jumping had insignificant difference between the indicators of heart rate in the morning on the day of jumps and before boarding the plane. Therefore, the heart rate of the adolescents newly engaged in parachuting does not undergo significant changes prior to boarding as compared with the original data. However, heart rate after the parachute jump, i.e., after landing, was significantly

higher. The difference in heart rate indicators before boarding an aircraft and immediately after landing was 81.7 bpm ($P < 0.05$). The parachutists of participation classes (aged 20-22 years) had the difference between heart rate at rest and before boarding the plane equal to 10.1 bpm ($P < 0.05$). This value was higher than the HR indicators of adolescent beginners. The difference between the values of the heart rate obtained before boarding and after landing was 69.6 bpm ($P < 0.05$). This value was 12.1 bpm less as compared with the heart rate of the beginners. Consequently, the parachutists of participation classes have significant reduction in their heart rate response as compared with adolescents aged 16-17 years. The masters of sports in parachuting had the difference between heart rate at rest and before boarding the plane equal to 14.3 bpm ($P < 0.05$). Immediately after landing, the heart rate of the masters of sports in parachuting was 69.9 bpm higher than the original value. Thus, the difference between the indices of heart rate before boarding the plain and immediately after landing in the athletes of participation classes and the masters of sports was almost equally pronounced, i.e. in the range of 69-70 bpm. The masters of sports of international class (under 35 years old), had insignificant difference between the values of the heart rate at rest and before boarding the plain. Immediately after landing, the heart rate of the masters of sports of international class in parachuting was recorded at the level of 97.4 ± 1.7 bpm. The difference between the values of heart rate before boarding the plane and immediately after landing in the masters of sports of international class was significantly lower than that of the previous groups examined and was only 14.7 bpm ($P < 0.05$). We also conducted a study of indicators of cardiac pumping function in the former masters of sports in parachuting. The heart rate of veterans of parachuting sport in the morning of the day of jumps was 101.7 ± 1.9 bpm. Before boarding the plane, heart rate was significantly lower than in the morning, and was recorded at the level of 91.5 ± 1.4 bpm ($P < 0.05$). However, immediately after landing, heart rate was significantly higher and amounted to 187.4 ± 1.3 bpm. The difference between heart rate before boarding the plane and immediately after landing in the former masters of sports was 95.9 bpm ($P < 0.05$). We should note that this value was significantly higher as compared with all previous groups. Thus, subject to the foregoing, we can argue that as the athletes develop their skills, the difference between the values of heart rate prior to and after landing decreases significantly in all athletes. It should be also noted that the rates of heart rate decrease are expressed differently. The least difference in heart rate values was recorded only in the masters of sports of international class. While the athletes of participation classes and masters of sports have this difference maintained at a high level of nearly 69-70 bpm ($P < 0.05$). We should note that the maximum difference in heart rate values prior to and after landing was recorded in ex-masters of sports. The difference between these indicators was

95.9 bpm, while this difference in the beginners, i.e., teenagers without experience in jumping, was only 81.7 bpm, which is 14.2 bpm less than the difference between the heart rates of the former masters of sports. Most probably, not only the level of fitness of the athletes, but also their psychological adaptation affected the reduction in difference between heart rates before and after the jump. We also analyzed the changes in stroke volume of the parachutists at various stages of preparation for the jump and after landing. According to our research, the beginners in parachuting, i.e. 16-17-year-old adolescents, had stroke volume in the morning of the day of jumps immediately after getting up equal to 37.7 ± 1.9 ml (Table 2). Before boarding the plane, stroke volume was 40.5 ± 1.4 ml. The difference between the stroke volumes in the morning and before boarding the plane was insignificant. Therefore, the beginners had no significant changes in their stroke volume before boarding the plane, as compared with stroke volume values obtained in the morning of the day of jumps immediately after getting up. After jumping with a parachute, i.e., immediately after landing, the stroke volume value was only 28.4 ± 1.4 ml. The difference in stroke volumes before boarding the plane and immediately after landing was 12.1 ml ($P < 0.05$). Consequently, the new parachutists, i.e. those having no experience in parachuting, showed no significant changes in their stroke volume prior to boarding the plane. However, immediately after landing, these parachutists had a significant reduction in their stroke volume identified. Stroke volume of the parachutists of participation classes (aged 20-22 years) was maintained at the level of about 51-55 ml both before boarding and after the jump, i.e., after landing. The masters of sports in parachuting had their stroke volume in the morning of the day of jumps immediately after getting up equal to 67.4 ± 1.4 ml. Before boarding the plain, stroke volume of these athletes increased slightly (7.3 ml) and reached 74.7 ± 1.3 ml ($P < 0.05$). The recording of stroke volume of the masters of sports in parachuting immediately after landing founded insignificant difference from the stroke volume values obtained before boarding the plane, which was 72.5 ± 1.2 ml. Consequently, the masters of sports in parachuting have some increase in their stroke volume just before boarding the plane. Stroke volume of the masters of sports of international class (under 35 years old) in the morning of the day of jumps immediately after getting up was 62.7 ± 1.4 ml. Just before boarding the plane, stroke volume of the athletes increased by 18.7 ml and reached 81.4 ± 1.3 ml ($P < 0.05$). Immediately after landing, stroke volume of the masters of sports of international class in parachuting was registered at the level of 98.7 ± 1.7 ml. The difference between the stroke volume values of the masters of sports of international class before boarding the plane and immediately after landing was 17.3 ml ($P < 0.05$). Consequently, stroke volume of highly qualified parachutists increased significantly both before boarding the plane and immediately after landing, as compared with the initial

values. We also conducted a study of indicators of cardiac pumping function in the former masters of sports in parachuting. The stroke volume of veterans of parachuting sport in the morning of the day of jumps was 54.3±1.3 ml. Before boarding the plane, stroke volume was registered at the level of 48.9±1.4 ml, which is not significantly different from the values reported in the morning at rest. However, immediately after landing, stroke volume was significantly lower as compared with the values obtained before boarding the plane and was 35.4±1.7 (P<0.05). The difference between these two indicators was 13.5 ml (P<0.05).

Summary

- as the athletes develop their skills, the difference between the values of heart rate prior to and after landing decreases significantly in all athletes;
- the least difference in heart rate values prior to and after landing was recorded in the masters of sports of international class;
- the maximum difference in heart rate values prior to and after landing was recorded in the former masters of sports;
- as the parachutists upgrade their level of fitness, the stroke volume response, on the contrary, increases.

Table 1 : Parachutists’ heart rate.

Group	n (qty)	Age	At rest (in supine position)	Before boarding the plane	After jumping (landing)
Parachutists beginners	17	16-17	107.4±1.7	115.7±1.4*	197.4±1.5*
Participation class sportsmen	21	20-22	97.7±1.9	107.8±1.3*	177.4±1.8*
Masters of sports	19	24-26	81.5±1.7	95.8±1.4*	165.7±1.9*
Master of sports of international class	18	under 35	80.4±1.7	82.7±1.4	97.4±1.7*
Former masters of sports	9	40-45	101.7±1.9	91.5±1.4*	187.4±1.3*

* – significant as compared with the previous values (P≤0.05)

Table 2 : Parachutists’ stroke volume.

Group	N (qty)	Age	At rest (in supine position)	Before boarding the plane	After jumping (landing)
Parachutists beginners	17	16-17	37.7±1.9	40.5±1.4	28.4±1.7*
Participation class	21	20-22	55.7±1.8	51.4±1.3	50.7±1.4

sportsmen					
Masters of sports	19	24-26	67.4±1.4	74.7±1.3*	72.5±1.2
Master of sports of international class	18	under 35	62.7±1.4	81.4±1.3*	98.7±1.7*
Former masters of sports	9	40-45	54.3±1.3	48.9±1.4	35.4±1.7*

* – significant as compared with the previous values ($P \leq 0.05$)

Conclusion.

Subject to the foregoing, we can argue that as the parachutists upgrade their level of fitness, the stroke volume response increases. However, we detected a negative stroke volume response for the first time in both the beginners and the ex-masters of sports after the jump. Increased stroke volume response of the masters of sports and masters of sports of international class before boarding and after landing is most likely explained by the fact they perform more difficult jumps. They perform various long jumps and the complex acrobatic elements. All this requires alertness, concentration and synchronicity. The risk of exercise increases with the growing complexity of jumps. Negative stroke volume response identified in the new parachutists and the former masters of sports after jumping with a parachute, in our opinion, is due to high heart rate. At high heart rate, the diastolic pause of heart decreases, reducing thereby the ventricular filling, which results in a decreased stroke volume of the parachutists.

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