Клінічна фізіологія та біохімія

UDC 612.13–072.7:796.325–05

*L.A. SARAFYNYUK, Yu.I. YAKUSHEVA
M. Pirohov Vinnitsa National Medical University*

Rheographic indicators of central hemodynamics in volleyball players of different positions

The problem of optimal functional state of the cardiovascular system of sportsmen is determined by short-term objectives training for the particular sporting event, as well as its long-term, providing high sports achievements over a long period of time. Leading limiting chain at a rate of physical performance of athlete is the state of cardiovascular system [2, 5], so the studies of parameters of central hemodynamics of athletes in a particular sport are actually and it isn't loses practical importance nowadays.

Purpose of our study was to establish the characteristics of rheographic indexes of central hemodynamics in volleyball players of high level of sportsmanship total youth groups and various sports positions.

Materials and methods. The study involved female persons of youthful age (16 to 20 years old) [4]. Commission on Bioethics of Vinnitsa National Medical University M.I. Pirogov (report N 2 dated February 4, 2014) established that the studies did not deny the main bioethical norms of the Helsinki Declaration adopted by the General Assembly of the World Medical Association, Council of Europe Convention on Human Rights and Biomedicine (1977), relevant provisions of World Health Organization, International Council of Scientific Medical Societies, International Code of Medical Ethics (1983) and the laws of Ukraine and may be used in scientific work. Among them were: 140 girls who did not involve in sports at the time of the survey were almost healthy and 116 volleyball players of high level sports training (from the first level to the adult masters of sport). They were divided into 3 groups for sports roles: hitters – 78 (67,24 %); setters – 29 (25 %); libero – 9 (7,76 %). Rheographic parameters determined by computer diagnostic complex provides simultaneous registration of ECG, tetrapolar rheogram and blood pressure. Given the performance ECG, the distance between the electrodes, height and weight and body surface area, systolic, diastolic and mean arterial pressure, heart rate using formulas we calculated indicators of central hemodynamics [6]. Reliability of difference values between independent quantitative variables were determined using the U-Mann-Whitney criterion.

Research results and discussion. When comparing the indices of systolic, diastolic and mean arterial pressure between youth girls who are not involved in sports and volleyball players with high level of sportsmanship of the same age we have not found any significant differences between group comparisons. The indicators of blood pressure are almost on the same level either volleyball players or different roles sports (Table). In the works of O. Lezhnovoyi [1] was also found that

youth male volleyball players of all indicators of blood pressure had no significant differences compared with the control group, although was set that the tendency to decrease the value in this indicator compared with volleyball players, football players and wrestlers.

One of the important indicators of central hemodynamics is stroke volume, which is not by female athletes significantly lower than in the total group of athletes and volleyball players of different positions: hitters, setters, libero; we have not found significant differences in the value of this indicator between the different volleyball sports specialization, although it should be noted that by libero the average value of this indicator is the highest (see Table). We found that volleyball players' minute volume of blood was significantly higher than girls who do not play sports, this regularity was observed in volleyball certain roles: hitters have this option significantly larger, but setters have a tendency to meaning its larger. We found out that the minute volume of volleyball players of different roles is on par. The size of stroke index has no significant differences when comparing the overall group, volleyball players and not athletes, but we found out, that by libero the figure has the greatest significance in the present sample, significant difference in the value of the hemodynamic parameter is set by comparing athletes of the roles of attackers and girls who are not involved in sports, significant difference in the value of the hemodynamic parameter is set by comparing athletes of the roles of hitters and girls who are not involved in sports. The value of cardiac index in the total group of athletes and volleyball players of different positions has no significant differences when compared with each other and with a group of girls who are not involved in sports (see Table).

**Features of hemodynamic parameters
in girls depending on sports activities ($M \pm \sigma$)**

Features	Position	$M \pm \sigma$	P_1	P_2	P_3	P_4
Arterial systolic pressure, mm Hg	Hitters	116,53 $\pm$ 8,91	–	> 0,05	> 0,05	> 0,05
	Setters	116,3 $\pm$ 10,41	> 0,05	–	> 0,05	> 0,05
	Libero	114,3 $\pm$ 9,59	> 0,05	> 0,05	–	> 0,05
	Volleyball players	116,3 $\pm$ 9,30	–	–	–	> 0,05
	Not athletes	115,6 $\pm$ 11,16	> 0,05	> 0,05	> 0,05	–
Blood pressure diastolic, mm Hg	Hitters	72,67 $\pm$ 7,35	–	> 0,05	> 0,05	> 0,05
	Setters	72,32 $\pm$ 10,04	> 0,05	–	> 0,05	> 0,05
	Libero	70,00 $\pm$ 11,30	> 0,05	> 0,05	–	> 0,05
	Volleyball players	72,36 $\pm$ 8,42	–	–	–	> 0,05
	Not athletes	71,21 $\pm$ 8,97	> 0,05	> 0,05	> 0,05	–
Average blood pressure, mm Hg	Hitters	86,96 $\pm$ 7,21	–	> 0,05	> 0,05	> 0,05
	Setters	86,68 $\pm$ 9,67	> 0,05	–	> 0,05	> 0,05
	Libero	84,55 $\pm$ 10,01	> 0,05	> 0,05	–	> 0,05
	Volleyball players	86,69 $\pm$ 8,10	–	–	–	> 0,05
	Not athletes	85,71 $\pm$ 8,56	> 0,05	> 0,05	> 0,05	–

1	2	3	4	5	6	7
Stroke volume, ml	Hitters	78,68 ± 16,08	–	> 0,05	> 0,05	< 0,001
	Setters	77,04 ± 15,15	> 0,05	–	> 0,05	< 0,05
	Libero	84,71 ± 8,28	> 0,05	> 0,05	–	< 0,01
	Volleyball players	78,76 ± 15,36	–	–	–	< 0,001
	Not athletes	69,15 ± 20,99	< 0,001	< 0,05	< 0,01	–
Minute volume of blood, l	Hitters	4,95 ± 0,991	–	> 0,05	> 0,05	< 0,01
	Setters	4,90 ± 1,001	> 0,05	–	> 0,05	< 0,055
	Libero	4,79 ± 0,56	> 0,05	> 0,05	–	> 0,05
	Volleyball players	4,93 ± 0,96	–	–	–	< 0,001
	Not athletes	4,57 ± 1,39	< 0,01	< 0,055	> 0,05	–
Impact index, ml/m ²	Hitters	43,32 ± 9,11	–	> 0,05	< 0,05	> 0,05
	Setters	45,75 ± 10,02	> 0,05	–	> 0,05	> 0,05
	Libero	51,22 ± 6,85	< 0,05	> 0,05	–	< 0,05
	Volleyball players	44,61 ± 9,39	–	–	–	> 0,05
	Not athletes	43,11 ± 12,75	> 0,05	> 0,05	< 0,05	–
Cardiac index, l/m ²	Hitters	2,77 ± 0,62	–	> 0,05	> 0,05	> 0,05
	Setters	2,95 ± 0,71	> 0,05	–	> 0,05	> 0,05
	Libero	2,92 ± 0,43	> 0,05	> 0,05	–	> 0,05
	Volleyball players	2,83 ± 0,63	–	–	–	> 0,05
	Not athletes	2,87 ± 0,83	> 0,05	> 0,05	> 0,05	–
Specific peripheral resistance, Din/s/cm ⁵	Hitters	32,78 ± 7,358	–	> 0,05	> 0,05	> 0,05
	Setters	30,76 ± 7,149	> 0,05	–	> 0,05	> 0,05
	Libero	29,79 ± 7,396	> 0,05	> 0,05	–	> 0,05
	Volleyball players	32,01 ± 7,322	–	–	–	> 0,05
	Not athletes	32,05 ± 9,325	> 0,05	> 0,05	> 0,05	–
Total peripheral resistance, Din/s/cm ⁵	Hitters	1454,5 ± 305,4	–	> 0,05	> 0,05	< 0,05
	Setters	1462,2 ± 304,0	> 0,05	–	> 0,05	> 0,05
	Libero	1433,4 ± 271,5	> 0,05	> 0,05	–	> 0,05
	Volleyball players	1454,7 ± 299,8	–	–	–	< 0,01
	Not athletes	1620,7 ± 472,4	< 0,05	> 0,05	> 0,05	–
Volume velocity of blood, ml/s	Hitters	289,0 ± 53,46	–	> 0,05	> 0,05	< 0,001
	Setters	281,2 ± 49,98	> 0,05	–	> 0,05	< 0,01
	Libero	303,0 ± 33,53	> 0,05	> 0,05	–	< 0,01
	Volleyball players	288,2 ± 51,14	–	–	–	< 0,001
	Not athletes	254,3 ± 74,14	< 0,001	< 0,01	< 0,01	–

1	2	3	4	5	6	7
Capacity of the left ventricle, W	Hitters	3,345 ± 0,666	–	> 0,05	> 0,05	< 0,001
	Setters	3,232 ± 0,609	> 0,05	–	> 0,05	< 0,01
	Libero	3,405 ± 0,452	> 0,05	> 0,05	–	< 0,05
	Volleyball players	3,321 ± 0,634	–	–	–	< 0,001
	Not athletes	2,912 ± 0,922	< 0,001	< 0,01	< 0,05	–
Energy consumption, W/l	Hitters	0,195 ± 0,018	–	> 0,05	> 0,05	> 0,05
	Setters	0,192 ± 0,021	> 0,05	–	> 0,05	> 0,05
	Libero	0,197 ± 0,023	> 0,05	> 0,05	–	> 0,05
	Volleyball players	0,194 ± 0,019	–	–	–	> 0,05
	Not athletes	0,191 ± 0,019	> 0,05	> 0,05	> 0,05	–

Notes: p_1 – an indicator of statistical significance of differences in hemodynamic parameters by hitters with other groups; p_2 – an indicator of statistical significance of differences in hemodynamic parameters by setters with other groups; p_3 – an indicator of statistical significance of differences in hemodynamic parameters by libero with other groups; p_4 – an indicator of statistical significance of differences in hemodynamic parameters by not athletes with other groups.

We found out that the value of the specific peripheral resistance has no significant difference between groups volleyball, a total group of sportsmen and not athletes, it should be noted that by libero the figure is the lowest average value, by hitters – the highest, difference by comparing these groups are unreliable (see. Table). Total peripheral resistance by not athletes is not significantly greater than in the general group of volleyball players and hitters. Between volleyball with different command specialization the changes in the value of rate are unreliable, by libero – the lowest value of this indicator, the setters – the largest. Girls, who are not involved in sports, significantly concede in size volume speed of blood than volleyball players', we found significant differences in the value of this parameter between the control group and the entire group of athletes and a separate group of hitters, setters and libero. By libero the average value of this indicator largest in the present sample, but the difference between athletes of different positions is insignificant. Sports-women, who are engaged in volleyball, have more power of left ventricle than girls who do not play sports. There was set significant differences at comparison values of the hemodynamic parameter between the group of not athletes, volleyball players and total group, hitters, setters and libero. Such hemodynamic indicator, as energy costs does not have any significant differences between the comparison groups (see. Table).

Morph functional features of cardiovascular determine the level of possible sporting achievements in any sport [3]. It was found that the specificity of sports activities significantly affects the value of stroke volume of blood: by football players in this figure has the greatest value, by wrestler – the lowest, by athletes also was found large enough average values of stroke volume and was established significant differences between them, volleyball players and not athletes. In boys engaged in football and athletics, the shock value index is the biggest, in volleyball players and wrestler – the lowest. Indicator of energy expenditure is the largest in football players and the least in volleyball players and boys who are not involved in sports [7].

Conclusions. It was established that the stroke and cardiac output, stroke index, volume and velocity of the blood and capacity of the left ventricle of volleyball players have significantly higher values, but total

peripheral resistance – have significantly lower values compared with girls who are not involved in sports. The significant differences of most indicators of central hemodynamics were not found between volleyball players of different positions, except for the shock index, that is by libero significantly greater than forwards.

REFERENCES

1. *Lezhnova A.V.* Fonts of rheographic indicators and indicators of central hemodynamics of athletes in different sports / O.V. Lezhnova // Biomedical and Biosocial Anthropology. – 2008. – N 11. – P. 178–182.
2. *Mikhalyuk E.L.* Features of electrocardiographic changes in individuals, professional athletes (review) / E.L. Mikhalyuk, S.N. Malakhov, A.A. Shard // Aktualni supply medical science and practice. Zbirnik naukovykh prats. – Zaporizhzhya: ZMAPO. – 2011. – VIP. 78. – Vol.1, book. 1. – P. 142–148.
3. *Mykhalyuk E.L.* State of central hemodynamics, cardiac rhythm and physical capacity in-class handball / E.L. Mykhalyuk // Physiological magazine. – 2009. – Vol. 55, N 2. – P. 72–75.
4. *Nykytyuk B.A.* Human morphology / B.A. Nykytyuk, V.P. Chtetsov. – M., 1990. – P. 332–342.
5. *Preliminary study of cardiorespiratory deconditioning in athletes after anterior cruciate ligament reconstruction* / N. Olivier, R. Legrand, J. Rogez [et al.] // Ann. Readapt. Med. Phys. – 2006. – Vol. 49, N 8. – P. 589–594.
6. *Ronkyn M.A.* Rheography clinical practice / M.A. Ronkyn, L.B. Ivanov. – M.: MBN, 1997. – 403 p.
7. *Sarafynyuk L.A.* Rheographic indicators of central hemodynamics in youth athletes in various sports / L.A. Sarafynyuk, A.V. Lezhnova // Bulletin morphology. – 2011. – Vol. 17, N 2. – P. 397–401.

Стаття надійшла до редколегії 09.06.2015

РЕОГРАФІЧНІ ПОКАЗНИКИ ЦЕНТРАЛЬНОЇ ГЕМОДИНАМІКИ У ВОЛЕЙБОЛІСТОК РІЗНОГО АМПЛУА

Л.А. САРАФИНЮК, Ю.І. ЯКУШЕВА

Вінницький національний медичний університет ім. М.І. Пирогова

З'ясовано, що деякі показники центральної гемодинаміки (ударний та хвилинний об'єм, ударний індекс, об'ємна швидкість руху крові й потужність лівого шлуночка) у волейболісток мають достовірно більші значення, а загальний периферійний опір – достовірно менші значення, ніж у дівчат, що не займаються спортом. Між волейболістками різного амплуа у значеннях більшості показників центральної гемодинаміки достовірних відмінностей не виявлено.

Ключові слова: реографія, параметри центральної гемодинаміки, волейболістки, амплуа, юнацький вік.

РЕОГРАФИЧЕСКИЕ ПОКАЗАТЕЛИ ЦЕНТРАЛЬНОЙ ГЕМОДИНАМИКИ У ВОЛЕЙБОЛИСТОК РАЗНОГО АМПЛУА

Л.А. САРАФИНЮК, Ю.И. ЯКУШЕВА

Винницкий национальный медицинский университет им. Н.И. Пирогова

Установлено, что отдельные показатели центральной гемодинамики (ударный и минутный объем, ударный индекс, объемная скорость движения крови и мощность левого желудочка) у волейболисток имеют достоверно большие значения, а общее периферическое сопротивление – достоверно меньшие значения по сравнению с девушками, которые не занимаются спортом. Между волейболистками разного амплуа в величине большинства показателей центральной гемодинамики достоверных различий не выявлено.

Ключевые слова: реография, параметры центральной гемодинамики, волейболистки, амплуа, юношеский возраст.