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Fundamentals Of The Physiology Of The Circulatory System.

Makhov AS, and Medvedev IN*.

Russian State Social University, st. V. Pika, 4, Moscow, Russia, 129226

ABSTRACT

Blood circulation is a process of continuous movement of blood through a closed cardiovascular system, providing vital functions of the body. The blood supplies the body's cells with oxygen, nutrients, water, salts, vitamins, hormones, and removes carbon dioxide from the tissues, the final products of metabolism. It also exchanges gases in the lungs and tissues, maintains the constancy of body temperature, provides humoral regulation and interconnection of organs and organ systems in the body. Multiple functions of blood can be carried out only in the conditions of its continuous movement in the vessels, that is, in conditions of blood circulation. Of particular importance is blood circulation for cells of multicellular organisms that have lost direct contact with the external environment and are in the surrounding liquid medium — the tissue fluid, from which the necessary substances are drawn and where they release the metabolic products. The composition of the tissue fluid is constantly updated due to the fact that this fluid is in close contact with the continuously moving blood, which carries out a number of its inherent functions. Oxygen and other substances necessary for the cells continuously penetrate from the blood into the tissue fluid. In the blood, from the tissue fluid all the metabolic products of cells are received for subsequent removal from the body. The blood moves through the vessels due to periodic contractions of the heart. When the heart stops, death occurs because the delivery of oxygen and nutrients to the tissues stops, as well as the release of tissues from metabolic products.

Keywords: heart, blood vessels, blood circulation, hemocirculation, metabolism.

Corresponding author

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INTRODUCTION

Blood circulation is a continuous movement of blood through a closed cardiovascular system, providing vital body functions. Blood supplies the body's cells with oxygen, nutrients, water, salts, vitamins, hormones, and removes carbon dioxide from the tissues, the end products of metabolism, and also exchanges gases in the lungs and body tissues, maintains body temperature, provides humoral regulation and organ interconnection and organ systems in the body. The circulatory system consists of the heart and blood vessels (arteries, veins, capillaries) that penetrate all organs and tissues of the body [1, 2].

Through the arteries, blood flows from the heart to the tissues. According to the current of blood, they branch out tree-like into smaller and smaller vessels - arterioles, which, in turn, fall into the system of the thinnest vessels - capillaries [3]. The functional significance of capillaries is especially great - these are the smallest vessels through which the running blood provides metabolism in all tissues and organs [4]. The capillary wall is constructed from a single layer of cells and is so thin (its thickness does not exceed 0.005 mm, or 5 microns) that various substances from the blood easily penetrate through it into tissues and from tissues into the blood. Through the veins, blood returns to the heart. Small and medium veins are equipped with valves that prevent the reverse flow of blood in these vessels [5].

Objective: to review and summarize the available information on the functioning of the circulatory system.

STRUCTURE AND FUNCTION OF THE CIRCULATORY SYSTEM

The circulatory system consists of the heart and blood vessels: blood and lymphatic.

The main value of the circulatory system is the supply of blood to the organs and tissues. The heart at the expense of its injection activity ensures the movement of blood through a closed system of blood vessels. The blood moves continuously through the vessels, which allows it to perform all vital functions, namely transport (oxygen and nutrient transfer), protective (contains antibodies), regulatory (contains enzymes, hormones and other biologically active substances) [6].

Blood circulation is a continuous movement of blood through a closed cardiovascular system, providing an exchange of gases in the lungs and body tissues. In addition to providing tissues and organs with oxygen and removing carbon dioxide from them, the blood circulation delivers nutrients, water, salts, vitamins, hormones to the cells and removes the end products of metabolism, and also maintains the constancy of body temperature, provides humoral regulation and interconnection of organs and organ systems body [7].

The circulatory system consists of the heart and blood vessels that permeate all organs and tissues of the body. Blood circulation begins in the tissues, where the metabolism takes place through the walls of the capillaries. The blood that donated oxygen to organs and tissues enters the right half of the heart and is sent to them in the small (pulmonary) circulation, where the blood is saturated with oxygen, returns to the heart, enters the left half of it, and is again distributed throughout the body (the large circulation) . The heart is the main organ of the circulatory system. It is a hollow muscular organ consisting of four chambers: two atria (right and left), separated by an interatrial septum, and two ventricles (right and left), separated by an interventricular septum. The right atrium communicates with the right ventricle through the tricuspid, and the left atrium with the left ventricle through the bicuspid valve. The average heart mass of an adult is about 250 g for women and about 330 g for men. The length of the heart is 10–15 cm, the transverse size is 8–11 cm and the anteroposterior - 6–8.5 cm. The average heart size for men is 700–900 cm3, and for women - 500–600 cm3. The outer walls of the heart are formed by the heart muscle, which is similar in structure to striated muscles. However, the heart muscle is distinguished by the ability to automatically rhythmically contract due to the pulses that occur in the heart itself, regardless of external influences (automatic heart) [8].

The function of the heart is the rhythmic pumping of blood in the arteries that comes to it through the veins. The heart contracts about 70-75 times per minute in the resting state of the body (1 time in 0.8 s). More than half of this time it rests - relaxes. The continuous activity of the heart consists of cycles, each of which consists of contraction (systole) and relaxation (diastole) [9].

Thus, during the whole cycle of the atrium, they work 0.1 s and rest 0.7 s, the ventricles work 0.3 s and 0.5 s. This explains the ability of the heart muscle to work without tiring, throughout life. The high performance of the heart muscle is due to increased blood supply to the heart. Approximately 10% of the blood ejected by the left ventricle into the aorta enters the arteries extending from it, which feed the heart. Arteries are blood vessels that carry oxygenated blood from the heart to organs and tissues (only the pulmonary artery carries venous blood) [10].

The artery wall is represented by three layers: the outer connective tissue sheath; medium, consisting of elastic fibers and smooth muscles; internal, formed endothelium and connective tissue. In humans, the diameter of the arteries varies from 0.4 to 2.5 cm. The total blood volume in the arterial system averages 950 ml. Arteries gradually tree-like branch into smaller and smaller vessels - arterioles, which pass into the capillaries [9].

Capillaries are the smallest vessels (average diameter does not exceed 0.005 mm, or 5 microns), penetrating the organs and tissues of animals and humans with a closed circulatory system. They connect the small arteries - arterioles with small veins - venules. Through the walls of capillaries consisting of endothelium cells, gases and other substances are exchanged between the blood and various tissues.

Veins are blood vessels that carry blood saturated with carbon dioxide, metabolic products, hormones and other substances from tissues and organs to the heart (except pulmonary veins that carry arterial blood). The wall of the vein is much thinner and more elastic than the wall of the artery. Small and medium veins are equipped with valves that prevent the reverse flow of blood in these vessels. In humans, the blood volume in the venous system averages 3200 ml [11].

CIRCULATORY FUNCTION

The movement of blood in the body occurs in two closed vascular systems connected to the heart, the large and small circulation. The systemic circulation (corporal) begins with the aorta, which moves away from the left ventricle. The aorta gives rise to large, medium and small arteries. Arteries pass into arterioles, which end in capillaries. Capillaries wide network penetrate all organs and tissues of the body. In the capillaries, the blood gives up oxygen and nutrients, and from them receives the products of metabolism, including carbon dioxide. The capillaries pass into the venules, the blood of which is collected in the small, medium and large veins. Blood from the upper torso enters the superior vena cava, from the inferior to the inferior vena cava. Both of these veins fall into the right atrium, which ends a large circle of blood circulation [12].

Pulmonary circulation (pulmonary) begins pulmonary trunk, which departs from the right ventricle and carries venous blood into the lungs. The pulmonary trunk branches into two branches, going to the left and right lung. In the lungs, the pulmonary arteries are divided into smaller arteries, arterioles and capillaries. In the capillaries, the blood gives off carbon dioxide and is enriched with oxygen. The pulmonary capillaries pass into the venules, which then form the veins. Through the four pulmonary veins, arterial blood enters the left atrium [13].

The blood circulating in the large circle of blood circulation provides all cells of the body with oxygen and nutrients and carries away metabolic products from them.

The role of the small circle of blood circulation is that in the lungs is the restoration (regeneration) of the gas composition of the blood [14].

AGE FEATURES OF THE CIRCULATORY SYSTEM

The human body has its own individual development from the moment of fertilization to the natural end of life. This period is called ontogenesis. It distinguishes two distinct stages: prenatal (from conception to birth) and postnatal (from birth to death). Each of these stages has its own characteristics in the structure and functioning of the circulatory system [15].

The embryo's heart formation starts from the 2nd week of prenatal development, and its development in general terms ends by the end of the 3rd week. The blood circulation of the fetus has its own characteristics,

primarily due to the fact that before birth, oxygen enters the body through the placenta and the so-called umbilical vein. The umbilical vein branches into two vessels, one nourishes the liver, the other connects to the inferior vena cava. As a result, in the inferior vena cava, oxygen rich blood is mixed with blood passing through the liver and containing metabolic products. Through the inferior vena cava, blood enters the right atrium. Then the blood passes into the right ventricle and then is pushed into the pulmonary artery; the smaller part of the blood flows into the lungs, and the greater part through the canal duct enters the aorta. The presence of botallova duct connecting the artery with the aorta, is the second specific feature in the circulation of the fetus. As a result of joining the pulmonary artery and the aorta, both ventricles of the heart pump blood into the systemic circulation. The blood with metabolic products is returned to the maternal organism through the umbilical arteries and the placenta. Thus, the circulation in the body of the fetus of mixed blood, its connection through the placenta with the maternal circulatory system and the presence of the canal duct are the main features of the fetal blood circulation [16].

In a newborn baby, the connection with the maternal organism is terminated and his own circulatory system assumes all the necessary functions. Botallov duct loses its functional significance and soon becomes overgrown with connective tissue. In children, the relative mass of the heart and the total lumen of the vessels are greater than in adults, which greatly facilitates the processes of blood circulation [17,18].

Also changes the shape and position of the heart in the chest. In newborns, the heart is spherical in shape and is located significantly higher than in an adult. These differences are eliminated only by the age of 10 [19].

Functional differences in the cardiovascular system of children and adolescents persist up to 12 years. Heart rate in children is greater than in adults. The heart rate in children is more susceptible to external influences: exercise, emotional stress, etc. Blood pressure in children is lower than in adults [20,21]. The stroke volume in children is significantly less than in adults. With age, the minute volume of blood increases, which provides the heart with adaptive abilities for physical activity [22,23].

During puberty periods, vigorous growth and development processes in the body affect the internal organs and, especially, the cardiovascular system [24-26]. At this age there is a discrepancy between the size of the heart and the diameter of the blood vessels [27]. With the rapid growth of the heart, the blood vessels grow more slowly, their lumen is not wide enough, and therefore the heart of an adolescent carries an additional load pushing blood through narrow vessels [28-31]. For the same reason, a teenager may have a temporary malnutrition of the heart muscle, fatigue, light breathlessness, unpleasant sensations in the heart area [32,33].

Another feature of the adolescent's cardiovascular system is that the heart of a teenager is growing very rapidly, and the development of the nervous system that regulates the work of the heart does not keep pace with it. As a result, adolescents sometimes have palpitations, abnormal heart rhythms, and the like. All of these changes are temporary and occur due to the peculiarity of growth and development, and not as a result of the disease [34,35].

CONCLUSION

The cells of multicellular organisms lose direct contact with the external environment and are in the surrounding liquid medium — tissue fluid, where they get the necessary substances from and where they secrete metabolic products. The composition of the tissue fluid is constantly updated due to the fact that this fluid is in close contact with the continuously moving blood, which carries out a number of its inherent functions. Oxygen and other substances necessary for the cells penetrate into the tissue fluid from the blood. In the blood, from the tissue fluid all the metabolic products of cells are received for subsequent removal from the body. Multiple functions of blood can be carried out only in the conditions of its continuous movement in the vessels, i.e. in terms of blood circulation. The blood moves through the vessels due to periodic contractions of the heart. When the heart stops, death occurs because the delivery of oxygen and nutrients to the tissues stops, as well as the release of tissues from metabolic products.

REFERENCES

[1] Bikbulatova AA, Andreeva EG. (2018) Achievement of psychological comfort in 5-6-Year-Old children with scoliosis against the background of daily medicinal-prophylactic clothes' wearing for half a year. Bali Medical Journal. 7(3): 706-711. DOI:10.15562/bmj.v7i3.947

[2] Vatnikov YuA, Zavalishina SYu, Seleznev SB, Kulikov EV, Notina EA, Rystsova EO, Petrov AK, Kochneva MV, Glagoleva TI. (2018) Orderly muscle activity in elimination of erythrocytes microrheological abnormalities in rats with experimentally developed obesity. Bali Medical Journal. 7(3) : 698-705. DOI:10.15562/bmj.v7i3.739

[3] Skoryatina IA, Zavalishina SYu. (2017) Ability to aggregation of basic regular blood elements of patients with hypertension anddyslipidemia receiving non-medication andsimvastatin. Bali Medical Journal. 6(3):514-520. DOI:10.15562/bmj.v6i3.553

[4] Bikbulatova AA, Andreeva EG. (2018) Restoration Of The Profile Of Bioregulators Of Blood Plasma In People Of Second Adulthood With Osteochondrosis Of The Spine Against The Background Of Daily Wearing Of Medical And Preventive Clothing. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4) : 413-419.

[5] Bikbulatova AA. (2018) Bioregulatory Effects Of The Daily Wearing Of Medical And Preventive Pants On The Body Of Pregnant Women Suffering From Habitual Miscarriages Of The Fetus. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4) : 889-896.

[6] Bikbulatova AA, Karplyuk AV. (2018) Professional And Labor Orientation Of Persons With Disabilities In The Resource Educational And Methodological Center Of The Russian State Social University. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4) : 1648-1655.

[7] Bikbulatova AA. (2018) Peculiarities of abnormalities of locomotor apparatus of children at preschool age with scoliosis of I-II degree living in Central Russia. Bali Medical Journal. 7(3): 693-697. DOI:10.15562/bmj.v7i3.738

[8] Bespalov DV, Kharitonov EL, Zavalishina SYu, Mal GS, Makurina ON.(2018) Physiological Basis For The Distribution Of Functions In The Cerebral Cortex. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5): 605-612.

[9] Maloletko AN, Yudina TN.(2017) (Un)Making Europe: Capitalism, Solidarities, Subjectivities. Contemporary problems of social work. 3 (3-11) : 4-5.

[10] Glagoleva TI, Zavalishina SYu, Mal GS, Makurina ON, Skorjatina IA. (2018) Physiological Features Of Hemo-coagulation In Sows During Sucking. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4):29-33.

[11] Zavalishina SYu, Makurina ON, Vorobyeva NV, Mal GS, Glagoleva TI. (2018) Physiological Features Of Surface Properties Of The Erythrocyte Membrane In Newborn Piglets. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4):34-38.

[12] Skorjatina IA (2018) Therapeutic Possibilities Of Rosuvastatin In The Medical Complex In Relation To Disaggregation Vascular Control Over Erythrocytes In Persons With Arterial Hypertension And Dyslipidemia. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(2) : 977-983.

[13] Apanasyuk LA, Soldatov AA. (2017) Socio-Psychological Conditions for Optimizing Intercultural Interaction in the Educational Space of the University. Scientific Notes of Russian State Social University. 16(5-144) : 143-150. doi: 10.17922/2071-5323- 2017-16-5-143-150.

[14] Pozdnyakova ML, Soldatov AA. (2017) The Essential and Forms of the Approaches to Control the Documents Execution. Contemporary problems of social work. 3 (1-9): 39-46. doi: 10.17922/2412-5466-2017-3-1-39-46.

[15] Vorobyeva NV, Mal GS, Skripleva EV, Skriplev AV, Skoblikova TV. (2018) The Combined Impact Of Amlodipin And Regular Physical Exercises On Platelet And Inflammatory Markers In Patients With Arterial Hypertension. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4) : 1186-1192.

[16] Bikbulatova AA, Karplyuk AA, Parshin GN, Dzhafar-Zade DA, Serebryakov AG. (2018) Technique for Measuring Vocational Interests and Inclinations in High-School Students with Disabilities. Psikhologicheskaya nauka i obrazovanie-psychological science and education. 23(2) : 50-58.doi: 10.17759/pse.2018230206

[17] Zhalilov AV, Mironov IS. (2018) Identification Of The Most Significant Shortcomings Of Sports Competitions In Sambo Among People With Hearing Impairment In A Separate Region Of Russia. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(3) : 672-677.

[18] Alifirov AI, Mikhaylova IV. (2018) Physical Education Of Highly Qualified Chess Players. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4) : 1725-1730.
[19] Gusarov AV, Kornev AV, Kartashev VP, Nekrasova MV. (2018) Effect Of Static Exercises With A Deflection On The Tone Of The Skeletal Musculature Of Middle-Aged Women. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(4) : 1716-1724.
[20] Makurina ON, Zaitsev VV, Kolesnikov AV, Sokol OV, Sadykhova AV. (2018) Aging changes' inhibition of hemostasis and blood rheological features on the background of antioxidant lipisomal preparation "Lipovitam-Beta" application. Bali Medical Journal. 7(1): 114-119. DOI:10.15562/bmj.v7i1.626
[21] Zavalishina SYu, Vatnikov YuA, Kubatbekov TS, Kulikov EV, Nikishov AA, Drukovsky SG, Khomenets NG, Zaykova EYu, Aleshin MV, Dinchenko OI, Glagoleva TI. (2018) Diagnostics of erythrocytes' early microrheological abnormalities in rats with experimentally developed obesity. Bali Medical Journal. 7(2): 436-441. DOI:10.15562/bmj.v7i2.740
[22] Makhova AV. (2018) Physiology Of The Hypothalamus In The Human Body. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 478-484.
[23] Maksimov VI, Zavalishina SYu, Parakhnevich AV, Klimova EN, Garbart NA, Zabolotnaya AA, Kovalev YuI, Nikiforova TYu, Sizoreva EI. (2018) Functional Activity Of The Blood Coagulation System Against The Background Of The Influence Of Krezacin And Gamavit In Newborn Piglets WhoUnderwent Acute Hypoxia. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 2037-2042.
[24] Maksimov VI, Zavalishina SYu, Parakhnevich AV, Klimova EN, Garbart NA, Zabolotnaya AA, Kovalev YuI, Nikiforova TYu, Sizoreva EI. (2018) Physiological Dynamics Of Microrheological Characteristics Of Erythrocytes In Piglets During The Phase Of Milk Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 454-459.
[25] Tkacheva ES, Zavalishina SYu. (2018) Physiological Features Of Platelet Aggregation In Newborn Piglets. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 36-42.
[26] Tkacheva ES, Zavalishina SYu. (2018) Physiological Aspects Of Platelet Aggregation In Piglets Of Milk Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 74-80.
[27] Tkacheva ES, Zavalishina SYu. (2018) Physiology Of Platelet Hemostasis In Piglets During The Phase Of Newborns. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 1912-1918.
[28] Zavalishina SYu. (2018) Physiological Mechanisms Of Hemostasis In Living Organisms. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 629-634.
[29] Zavalishina SYu. (2018) Functional Properties Of Anticoagulant And Fibrinolytic Activity Of Blood Plasma In Calves In The Phase Of Milk Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 659-664.
[30] Zavalishina SYu. (2018) Physiological Dynamics Of The Blood Coagulation System Activity In Calves During The Phase Of Dairy Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 680-685.
[31] Zavalishina SYu. (2018) Functional Activity Of The Blood Clotting System In Calves During The Phase Of Milk And Vegetable Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 720-725.
[32] Zavalishina SYu. (2018) Anti-Coagulant And Fibrinolytic Activity Of Blood Plasma In Healthy Calves Of Dairy-Vegetative Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 753-758.
[33] Bikbulatova AA. (2018) Technology Implementation Of Competitions Of Professional Skill. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 407-419.
[34] Bikbulatova AA, Kartoshkin SA, Pochinok NB. (2018) Schemes Of Competitions Of Professional Skills Among People With Disabilities In Russia. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 357-362.
[35] Bikbulatova AA, Matraeva LV, Erokhin SG, Makeeva DR, Karplyuk AV. (2018) Methodical Foundations Of Carrying Out Competitions Of Professional Skill Among People With Disabilities. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 9(5) : 243-247.