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About Mechanics of Influence of Infrasound on Living Organism

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Abstract

Infrasound is an important factor of the environment of modern man, whose body is supposed to function mainly on the frequencies of infrasound in terms of mechanical processes. The biological effect of infrasound on the living organism is manifested by disorders in the activity of the nervous and cardiovascular systems, energy metabolism, the structure of cell membranes. The materials considered in the article testify to the fruitfulness of ideas about the important role of infrasonic processes in the organization of human and mammal life. The accumulation of data in favour of such ideas has a wide scientific, theoretical and practical significance: a living organism is a part of nature and cannot exist outside of nature and its diverse phenomena, the laws of physics and chemistry that describe them. They are based on all processes of life, how complex and bio specific they were not. Therefore, the question of the ratio of living and non-living, external and internal environments of the body, external and internal oscillatory processes in human life and other living organisms, the mechanics of the effect of infrasound on them. It should be noted that the living organism is able to actively change the processes taking place in it, including those caused by infrasound. I've tried to show this in the example of the organization of lymph flow.

Keywords Organism; Organ; Lymph flow; Cell; Infrasound; Interaction; Mechanics

Introduction

Infrasound is an important factor of the environment, part of the noise generated by technological equipment in transport and industrial enterprises, household appliances. The human body in terms of mechanical processes functions mainly at infrasound frequencies, in the form of infra-low-frequency oscillations [1]. The biological effect of infrasound is manifested by disorders in the activity of primarily nervous and cardiovascular systems, energy metabolism, cell membrane structure [1, 2]. Changes in the cardiovascular system under the influence of infrasound are studied mainly on the heart and blood vessels, and at first the duration of the experiment ranged from half an hour to several days. The structure of lymphatic vessels and nodes under the influence of infrasound has not been studied before, although the lymphatic system plays an important role in the life of humans and mammals. Lymphatic vessels carry additional to veins drainage of all organs, including immune. Lymphatic vessels transport coarse particles, fats, proteins, toxins, bacterial and tumor cells. Violations of lymphatic drainage and lymphedema, is caused by damage to lymphatic vessels, leading to impaired function of the drained body [3-5]. Infrasound intensity of up to 110 dB has an information effect on the body, causing it mainly functional changes [2]. I have described the changes of lymphatic vessels and nodes under the influence of infra-sound of the information spectrum (100 dB) on living organism [6,7]. Studies have shown that such infrasound with short-term exposure (up to several days) on a living organism causes ultrastructural and morphometric changes in the lymphatic system, which are accompanied by significant functional changes in the body. With long-term (1 week or more) action of such infrasound, organic changes in the structure of the lymphatic system, leading to the disruption of the lymph transport and immunopath. The nature, size and speed of structural transformations in various parts of the lymphatic channel depend on their design, in particular-on the thickness and density of its walls. Consequently, the spread of infrasound in different environments of the biosystem depends on their size and density. Similar conclusions are made in the analysis of the results of studies of the distribution of infrasound in natural environments (atmosphere, sea, earth) and changes in different human organs under different weather conditions, noise effects, etc. [1,2,8-17]. Analysis of the literature data showed that the effect of infrasound on the living organism is not yet fully understood, but certain conclusions have already been made [1,8]:

1. Infrasound has a special ability to affect human health and adaptation, as its frequencies and amplitudes converge with those fluctuations that are generated by the human body.

2. The difference between the mechanical vibration of the whole human body and the direct absorption from the sound pressure becomes less important as the frequency decreases.

3. To understand the mechanisms by which external vibrations interact with the human body, it is necessary to know the features of its internal vibrations, which it will stimulate resonance phenomena.

3a. To solve this very complex issue requires an interdisciplinary approach in the organization of research, spatial and temporal analysis of the information received by the body from the outside (for example-the form of the incoming signal, its change and change time), which should be consistent with cell signaling and internal dynamics. The magnitude of the impact on the body is less important.

Studies conducted by different authors have shown that the characteristics of infrasound change with the change of its distribution medium (different density of the atmosphere layers, the transition from the atmosphere to the sea, the thickness of the earth, etc.). But the human body consists of different layers with different density and chemical composition, such as: bone, loose connective tissue and epithelium; more or less dense walls of the body cavities, internal organs or vessels and their contents, often liquid or air; membranes

and plasma cells. The duration of infra-sound effects on the body is important. In this article I will analyze the main conclusions from such literature sources and compare them with the results of the analysis of various data in my own works [6, 7].

Infrasound and lymph flow, comparison of their characteristics

Infrasound has two main components-variable pressure and oscillatory speed. Lymph flow is an oscillatory process in which not only the magnitude but also the direction of velocity are variables, which is associated with the constant presence of valves throughout the lymphatic vessels [7]. Slow, infrasonic-like waves propagate in the water-like walls of the aorta and its branches under the influence of the release of blood from the heart, committed during the systole with the frequency of infrasound [1]. In lymphatic vessels, slow waves of tone are similarly distributed. The connection of movements of different parts of the human body with infrasonic waves and oscillations can be caused by a number of mechanisms [1], which can be involved in the organization of lymph flow [7]: 1) compression and stretching of muscles, elastic waves in them. In the lymphatic vessels, the role of microcompression play muscular cuff of lymphangion. For myocytes characterized by variable modulus of elasticity, which is the basis of contractions of the lymph vessel, the active oscillations of its walls and lymph flow fluctuations in its cavity; 2) increased breathing and heart contractions, other functional changes in the body. But the movement of organs and vessels, the reduction of extravascular muscles can act as extravasal factors and accelerate the lymph flow; 3) the movement of the body and each part of it lead to the radiation of elastic waves, mainly infrasonic range. Elastic waves also occur with the reduction of lymphangions, they can be transmitted not only to the lymph and the lymph flow, but perianalny tissues and nerve receptors; 4) the movement of the human body occur in the atmosphere or water in the space with varying parameters, which corresponds to the provision in the body of the outer variable pressure, for example infrasound, which is clearly greater in the water. Lymph flow occurs in the lymphatic bed with different structure of the walls throughout (capillaries, postcapillaries, vessels, nodes, trunks, ducts, different parts of the vessels and lymphangions), functional (stress-strain) state and environment. Vessels spend a significant amount of blood and lymph. The flow rates of their layers, especially at acceleration, are not equal in wide, thick-walled vessels. Near-wall blood layers and lymphs with increased hydrostatic pressure at low speed can limit sound channels. Such channels on the deep sea provide long-distance propagation of infrasound [2]. Cell membranes and vascular walls lie on the border of different media and can serve as a place of inhibition of infrasound and a sharp increase in its pressure.

When exposed to the living organism infrasound "information spectrum" changes in the lymphatic system had pronounced local features [6]. With short-term exposure (up to several days) infrasound intensity of 100 dB and a frequency of 16 Hz caused ultrastructural and morphometric changes in the lymphatic system, which were accompanied by significant functional changes in the body. During long-term (1 week or more) exposed to infrasound there were organic changes in the structure of the lymphatic system, leading to disruption of the lymph transport and immunopath. The nature, size and speed of transformations in different parts of the lymphatic channel depend on their design, in particular-the thickness and density of its walls. Central and peripheral lymphatic vessels react differently (in speed and degree) to infrasound, because they have different structure. Thus, the diameter of the thoracic duct is 3.15 times greater than that of the lymph vessels of the broad ligament of the uterus, the wall thickness is 2.44 times greater, the number of myocytes in the entire thickness of the muscular cuff is 1.78 times greater, and in its main, middle muscle layer-1.53 times. Thus, the rigidity (rigidity) of the duct walls, determined by their geometric characteristics and elastic-viscous properties, is much higher than in peripheral lymphatic vessels. Adventitia can act as a protector for smooth myocytes: a significant decrease in their content, associated not with the dilation of the vessel, and with the death of cells in the peripheral lymphatic vessels found in the third week of the experiment, in the chest duct-in the fourth week; at the end of the experiment, the proportion of surviving myocytes was significantly higher in the duct, and during it-in the valve parts where the thickness of the adventitia is usually greatest. Lymph node is a part of continuous lymph flow pathways from organs with lymphoid nozzle (biofilter), it is arranged as a special lymphangion, complex (multi-valve) and complex (with lymphoid tissue in the walls) [4, 5]. In the early days of such experience to happen the swelling of the lymph nodes, the smoothing of their relief, swelling of the surrounding tissues, stretching of the capsule, the expansion brings the lymph vessels and marginal sinus (symptoms of acute lymphedema). During the second-third week of the experiment, lymph nodes remain enlarged, but unevenly, their surface becomes bumpy under pressure of lymphoid nodules, increasing in number and size. The capsule of lymph nodes is unevenly thickened with loosening of the network of thickening connective tissue fibers. Stretches the cell network of myocytes in the nodular zone of the capsule. In the first 2-3 weeks of the experience of the lymph node sinuses are expanded by 2-4 times, especially over the regional lymph node and vnutrizonovye, cortex and medulla. This indicates a sharp increase in indirect lymph flow and the development of lymphostasis. 4-5 weeks swelling of lymph nodes decreases, increasing the process of fibrosis. Lymph nodes are reduced in size and shrink, they are increasingly difficult to separate from the surrounding tissues. The thickness of collagen fiber bundles in the capsule, sinuses and lymph node substance increases. Elastic fibers become tortuous, in some places the network is fragmented. Thickening and compacting layers of connective tissue dissect the muscle layers in the capsule. Decreases the number of myocytes. Strongly narrowed sinuses and venules alternate with areas of their sharp local expansion. By 6 weeks of the experiment, the total number of lymphoid nodules is in the mesenteric lymph node below the control level is 21%, and the secondary nodules-5.8 times. In the popliteal lymph node, the total number of nodules, decreasing, remains 1.5 times greater than in the control, and the secondary nodules-half. At 6 weeks the lymphoid nodules are loosely in the cavity of the marginal sinus of mesenteric lymph node even. Rare germ centers of lymphoid nodules have the appearance of shrivelled, small lumps with signs of decay. And the relative area of the paracortical zone of lymph nodes is much higher than the control values at the same time. The contouring of T-domains deteriorates, their light centers and peripheral rims are fragmented. Part of the T-domains are devastated, above them are decaying lymphoid nodules. The obtained data indicate the comparability of changes in the structure of the lymph node and lymphatic vessel, occurring under the influence of infrasound: 1) primary decompensation manifested morphometric increase in swollen lymph node and expand his sinuses (1-2 weeks); 2) compensatory processes-intensification of indirect lymph flow and immunopath with a preferential increase in cortical substance of a lymph node (2-3 weeks); 3) later, there are growing signs of decompensation all of its functions, disorders of lymph transport, and the extinction of immunoplate (focal depletion and devastation of the

parenchyma in terms of lymphostasis and venous congestion). In contrast to lymphatic vessels, especially peripheral ones, lymph flow pathways in the lymph node have much more massive walls, that is due to the greater thickness of the capsule and the presence of lymphoid tissue. It inhibits the expansion of the sinuses of the lymph nodes, especially in the context of progressive fibrosis. Therefore, lymph nodes increase more slowly and longer (the first 3 weeks of the experiment, peripheral lymph vessels-the first week, the chest duct – the first 2 weeks), decrease and shrink later.

Conclusion

The considered materials testify to the fruitfulness of ideas about the important role of infrasonic processes in the organization of lymph flow and the entire life of humans and mammals. The accumulation of data in favour of such ideas has a wide scientific, theoretical and practical significance: a living organism is part of nature and cannot exist outside of nature and its diverse phenomena, the laws of physics and chemistry that describe them. They are based on all processes of life, how complex and biospecific they were not. Therefore, the question of the ratio of living and non-living, external and internal environments of the body, external and internal oscillatory processes in human life and other living organisms, the mechanics of the effect of infrasound on them is so important. It should be noted that the living organism is able to regulate, actively change the processes taking place in it, including those caused by external influences, for example, infrasound. I tried to show this by the example of the organization of lymph flow under the influence of infrasound on a living organism.

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