

Modern biophysical view of electromagnetic processes of the phenomenon of life of living biological systems as a promising basis for the development of complex medicine: the role of water

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Abstract. The results of a theoretical study of the role of water in electromagnetic generation and in the process of realizing the phenomenon of life are presented in the article. This article is a continuation of the theoretical study of the team of authors, which was published in the Journal of Complexity in Health Sciences, Vol. 5, Issue 1, 2022, p. 22-34. The aim of the theoretical study was to generalize the available scientific physical and biological knowledge of modern science about the role of water in the electromagnetic processes of the phenomenon of life at the cellular level in order to deepen the fundamental knowledge of Complex Medicine. This study is a fragment of research work on “Development of algorithms and technologies for implementing a Healthy Lifestyle in patients with Noncommunicable Diseases based on the study of functional status” (state registration number 0121U108237: UDC 613 616-056-06: 616.1/9-03). General scientific methods and theoretical methods were used in this theoretical study. The main conclusions of the theoretical study were made as follows: 1) The “30/11 helix” is the main most typical fragmentary element of water self-organization into fractal structures and it forms energy-intensive fractal crystalline filamentous water structures in living biological systems, supported by energy constantly coming from biopolymers, and forming large constantly growing hierarchical structures that unite all the water of a living organism in a dynamic balance of opposite processes of destruction and growth of its energy-intensive crystalline structures; 2) Water has a key role in the process of transmission and perception of the coherent energy of a soliton through self-organizing fractal energy-intensive paramagnetic crystalline structures in living biological systems; 3) The phenomenon of biological life at the micro level is characterized by the presence of a state of water binding/organization into energy-intensive crystalline structures due to the constant supply of coherent energy from biopolymers and stops when this energy flow disappears, which corresponds to the onset of the phenomenon of biological death and is manifested by the degradation of energy-intensive fractal crystalline self-organization of water to an unbound water state. solution devoid of so-called biological anomalies.

Keywords: magnetochemical theory of metabolism, water, liquid crystal, 30/11 helix, phenomenon of life, complex medicine.

Apparently, something very important, a whole dimension is missing in our current composition of thinking, without which it is impossible to find an approach to these problems.

Water is not only a matter, but also the matrix of life, and biology may not have succeeded so far in understanding the most obvious functions due to the fact that it has focused on matter in the form of particles, separating them from two matrices – water and electromagnetic field.

A. Saint-György

1. Introduction

Water is the main component of living biological systems. It makes up 80-90 % of the mass of plants, about 70 % of the mass of the body of animals and humans. The body of a monthly embryo consists of 97 % water, a newborn baby – 75-80 %, the elderly – up to 57 %. The human brain consists of 95 % water, blood – 82 %, lungs – 90 %. Reducing the content of water in the human body to 50 % is incompatible with life and leads to death. Modern science has long recognized and confirmed the role of water as a universal component for sustaining life. Water determines the structure and properties of many objects of animate and inanimate nature. The mechanisms of water participation in life processes were unknown for a long time. Water was considered as a solvent even when studying processes in vivo. Today it has already been proven that water in living biological systems is not a purely continuum medium and is not a liquid in the usual sense for human senses. Water is a substance with unique quantum mechanical characteristics due to the electromagnetic properties of its atomic structure. The study of the role of water in the implementation of biophysical processes of the phenomenon of life of biological systems is an urgent and important fundamental issue of Complex Medicine. The level of development of scientific knowledge of past eras and the lack of scientific understanding of the essence of electromagnetic processes occurring at the microlevel of matter, for a long time determined the consideration of water exclusively as a solvent and did not take into account the quantum mechanical features of its structure and its electromagnetic properties. The current level of scientific knowledge of fundamental quantum physics and quantum chemistry makes such an approach absolutely absurd and unacceptable. The scientific view of the role of water has changed radically [1-7].

Water has a fundamentally important role in the organization and functioning of living biological systems of various levels of complexity. Water is a universal solvent, a reagent for many biochemical reactions (hydrolysis, redox reactions, etc.) and participates in the creation of a structural electromagnetic basis in tissues at the atomic-molecular level. This provides the possibility of generating and transferring energy between biological molecules and this realizes the phenomenon of life and causes the occurrence of biological anomalies of water in living organisms (features of electrical conductivity, freezing, etc.). However, the mechanisms for realizing this important role of water as an integral component of the magnetoelectrochemical basis of the phenomenon of life at the molecular level in living biological systems have long remained undiscovered and are still being studied [3, 5-9].

Therefore, the aim of the theoretical study was to generalize the available scientific physical and biological knowledge of modern science about the role of water in the electromagnetic processes of the phenomenon of life at the cellular level in order to deepen the fundamental knowledge of Complex Medicine.

2. Materials and methods

The analysis of the presented data is a fragment of research work of the Department of Internal Medicine and Emergency Medicine of Poltava State Medical University (23, Shevchenko St., 36011, Poltava, Ukraine) on “Development of algorithms and technologies for implementing a Healthy Lifestyle in patients with Noncommunicable Diseases based on the study of functional status” (state registration number 0121U108237: UDC 613 616-056-06: 616.1 / 9-03).

Scientific work is carried out in conjunction with the following scientific institutions: 1) Lithuanian University of Health Sciences (9, A. Mickevičius St., LT-44307, Kaunas, Lithuania), the cooperation coordinator is Head of Nephrology Department, prof., DM I. A. Bumblyte; 2) Shupyk National Healthcare University of Ukraine (9, Dorogozhytska St., 04112, Kiev, Ukraine), the cooperation coordinator is the Head of the Department of Informatics, Information Technologies and Transdisciplinary Education, prof., DM O. P. Mintser.

General scientific methods (dismemberment and integration of elements of the studied system,

imaginary experiment, logical, historical research, analysis, induction, deduction and synthesis of knowledge) and theoretical methods (method of constructing theory, logical methods and rules of normative nature) were used in this theoretical study.

3. Results and discussion

We realized when performing a theoretical study that the accumulation of knowledge regarding the properties of water and their scientific interpretation took place in accordance with the development of science in each of the epochs of mankind. The 21st century is a period of globalization and a significant breakthrough in magnetology and fundamental sciences. A large theoretical scientific base exists now. Opportunities for a logical systemic generalization of the available scientific information, the creation on this basis of a unified theory of metabolism, taking into account the previously discovered chemical and physical properties of water, also exist now.

It was concluded in the analysis and systematization of modern scientific knowledge that the unique physiological role of water in the life processes of living organisms and humans is based on its quantum mechanical properties. This is so because it is the quantum mechanical properties of water molecules that predetermine the possibility of implementing the mechanisms of energy transfer between biological molecules in living organisms. Therefore, we made an analysis of the properties of water discovered by science. Such basic quantum-mechanical features of the structure and properties of water were identified from the standpoint of complex / systems medicine, which make it possible to implement the mechanisms of energy transfer between biological molecules, such as:

- this is a spatial asymmetry of the water molecule with a significant shift between the negatively charged oxygen part and the positive hydrogen part of the molecule [1-6, 10-14, 19, 20];

- each water molecule is a miniature dipole with a high dipole moment [1-6, 10, 19, 20];

- water has the highest dielectric constant among all substances [1-6, 10, 19, 20];

- water has amphoteric properties; it can be both an acid and a base, it can be in coherent and incoherent states (L-, R-spin polarizations) due to its ionization property [3-6, 10, 19, 20];

- water has a dissymmetric structure; the oxygen part of the molecule has a negative charge, while the hydrogen part has a positive charge [3-6, 10, 19, 20];

- water is a complex system capable of self-organization; the polarity of water molecules, the presence of partially uncompensated electric charges in them creates groupings of molecules – structures of intermolecular associates of water (clusters) with the general formula $(H_2O)_n$, cluster ions $[(H_2O)_n]^+$ and $[(H_2O)_n]^-$, liquid crystal structures, fractal-cluster dissymmetric systems, etc.; water in the vapor state fully corresponds to the formula H_2O only, since the concentration of individual monomeric molecules of liquid water is $<1\%$ in the temperature range from 0 to $100^\circ C$, and all other molecules are combined into associates of varying degrees of complexity, and their composition is described by the general formula H_2O_x ; the reason for the formation of associates is the hydrogen bonds that arise between the hydrogen nuclei of some molecules and the electronic “clumps” of the oxygen nuclei of other water molecules [1-6, 10, 15, 19-23];

- water has the ability to emit photons/luminescence; This manifests itself to varying degrees depending on the energy state of the atoms of water molecules, the composition of water, and reflects the dynamics of processes that have formed in the water system under the influence of certain energized environmental factors; photon emission as a parameter for displaying the field characteristics of water is manifested for natural water, in contrast to treated tap water, which practically does not have its own glow, which is experimentally confirmed by photographic registration of such radiation and its amplification upon excitation of a high-frequency electric discharge above a drop [3, 16-18, 24];

- water has the properties of electrical conductivity, superconductivity, oscillation, energy and charge transfer, etc.; the functioning of a living biological system occurs synchronously and at the same time characteristic frequencies are determined in the ultra-high frequency range of

electromagnetic waves, which determine the temporal parameters of life processes; the same frequencies appear in the study of ordinary water in the spectra of microwave resonance interaction of low-intensity electromagnetic radiation with an aqueous medium [3-5, 10, 19-20, 25].

The appearance of magnetic properties, dissymmetry and the phenomenon of spin isomerism in water molecules is the result of these designated quantum mechanical parameters of its parameters. These three phenomena provide different physical properties of water in its different energy states when interacting with biopolymers of living systems and affect electromagnetic processes in biopolymers of living organisms. For a long time, the scientific progress of knowledge about water was hampered by the concept of water as a solvent. The physical properties of distilled water and various solutions were studied. Possible interactions of water with biopolymers have been studied *in vitro* with this scientific approach. However, scientists must understand that water *in vivo* is in fundamentally different conditions, which radically change many of its properties. Water in the cytoplasm of a living cell is not a continuum fluid and has a high concentration of dissolved substances that "bind" its molecules. Water forms coacervates with polymers in living organisms. It is in complete combination with polymers and loses its dissolving power. Self-organization of water molecules in living biological systems occurs in their internal environment - as a rule, in the cytoplasm. The cytoplasm of a cell is filled with cell organelles and biopolymers, small organic molecules and ions. The cytoplasm looks under a microscope as a chaotic accumulation of cellular elements that are in continuous movement in the cell. Biopolymers are located quite close to each other in the cytoplasm, but at the same time they are all separated by at least several monolayers of water, which are affected by the surfaces of biopolymers. These monolayers allow the molecules to "slide" freely relative to each other. Thus, it is clear to us that there is no free liquid water in the cytoplasm of the cell, or there is very little of it. Water interacts actively and differently with hydrophobic and hydrophilic surfaces of biopolymers, stabilizes their native structure, and at the same time, the structure of water in different surfaces of biopolymers also fundamentally changes. Hydrophobic interactions lead to an increase in the density of water in the form of layers parallel to hydrophobic surfaces, but there is no consensus regarding hydrophilic interactions. Extrapolation to living organisms of the results of experiments conducted *in vitro* with sufficiently diluted aqueous solutions of biopolymers, as well as the study of the conformation of biopolymers by computer simulation based on data on their primary structures obtained by mass spectrometric methods, cannot be objective and legitimate, since the complex of parameters *in vivo* in the internal environment/cytoplasm is completely different from the set of parameters in the array of pure (homogeneous, continual) water. The laws of classical chemistry and classical crystallography are categorically unsuitable for explaining the principles of self-organization of water molecules in living biological systems [3, 4, 6, 12, 13, 25-28].

An important scientific discovery for understanding the role of water in the electromagnetic processes of living organisms was the discovery of new states of aggregation of water in the form of liquid crystal forms of energy-intensive crystals. This discovery was not given due attention for a long time. But now this idea is very interesting and can explain many aspects of the electromagnetic physiology of living organisms. It has been scientifically proven that water molecules can form energy-free crystalline structures and energy-intensive crystalline structures, depending on external conditions (homogeneity of the liquid phase mass, impurity concentration, temperature and pressure), corresponding to the condition of a phase transition in nature. Ice is a form of energy-free crystals - this form does not require additional energy from external space to maintain it. Water is in fundamentally different conditions in living organisms, it forms the form of energy-intensive crystals in them. These energy-intensive crystals are formed in adhesion with biopolymers and retain their liquid-crystalline state and properties only if they constantly receive electromagnetic energy from biopolymer molecules. The liquid-crystalline state of water disappears in the absence of electromagnetic energy from the biopolymer to the water structure, and the water becomes liquid. To date, it has been established that energy-intensive fractal water

structures are the main form of water organization in living biological systems, including the human body. These scientific successes in theorizing ideas about the liquid-crystalline form of water have been achieved thanks to the creation and application of complex algorithms developed for nonlinear modular water crystallography and taking into account the water environment closest to a given molecule (pair potentials), collective processes for the entire aquatic environment. It was found that the main element of self-organization of water into fractal crystals is the structure, which received the name “30/11 helix” in water crystallography. Water molecules are organized in the form of a “30/11 helix” and in this form the basis of the structure of hydration shells of biopolymers in living biological systems (Fig. 1) [3, 26-31].

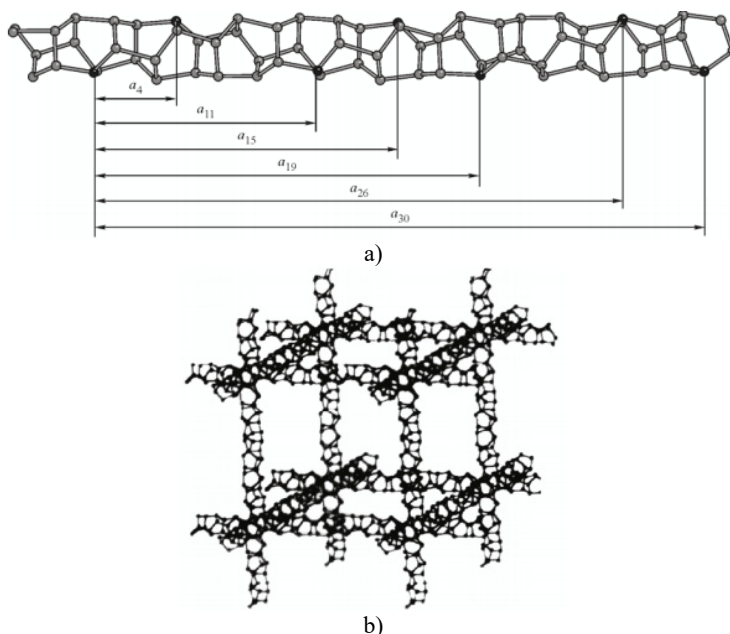


Fig. 1. Computer model of a fragment of an energy-intensive water crystal: a) 30/11 helix in a longitudinal view and its pseudoperiods in b) the form of a lattice with edges of 30/11 helices with angles between the edges of 90° in [3, 26]

The “30/11 helix” is a tube with an inner diameter of about 3.2 nm along an oxygen framework lined inside and out with protons according to this computer model. The repeating unit of the helix consists of two water molecules, and it grows eleven complete turns when thirty repeat units are attached, and this corresponds to a length/period along its axis $A_{30} = 44.12 \text{ \AA}$ at a hydrogen bond length of 2.75 \AA (Fig. 1, drawing from above). This structure is paramagnetic and is able to interact with external magnetic fields, including the Earth's magnetic field, due to the fact that protons have magnetic moments. The 12 helices can intersect into clusters of 27 water molecules using the so-called T-node. In this case, each central molecule of this cluster belongs to each of the helices and a lattice with edges is formed (Fig. 1, drawing from below). It is important that the crystallization of proteins *in vivo* occurs with the formation of an associated water lattice with ribs of “30/11 helix”. In this case, the parameters of the structured water lattice coincide with the parameters of the molecular cell of the protein crystal and turn out to be discontinuous and fractal. That is, conditionally large cells can be divided into smaller cells by “30/11 helix” emerging from the main lattice edges through smaller pseudoperiods. The appearance of such a lattice explains such properties of protein crystals as the low density of filling the cells of biocrystals with proteins (up to 20 vol.%), the possibility of a diverse arrangement of protein molecules in the cells depending on the conditions for the formation of a protein crystal, and the possible presence of wide empty channels filled with water molecules, significant polymorphism of biocrystals due to

the diversity of such lattices. The stabilization of the edges (“30/11 helix”) of the cells occupied by biomolecules occurs due to biopolymers and small precipitating ions, and in large planes - due to longer molecules of polyethylene glycol by fixed incorporation into the structure of the “30/11 helix” as one or two components of the helix 15/4. This can be seen on the electron density map during simulation (Fig. 2(b-d)).

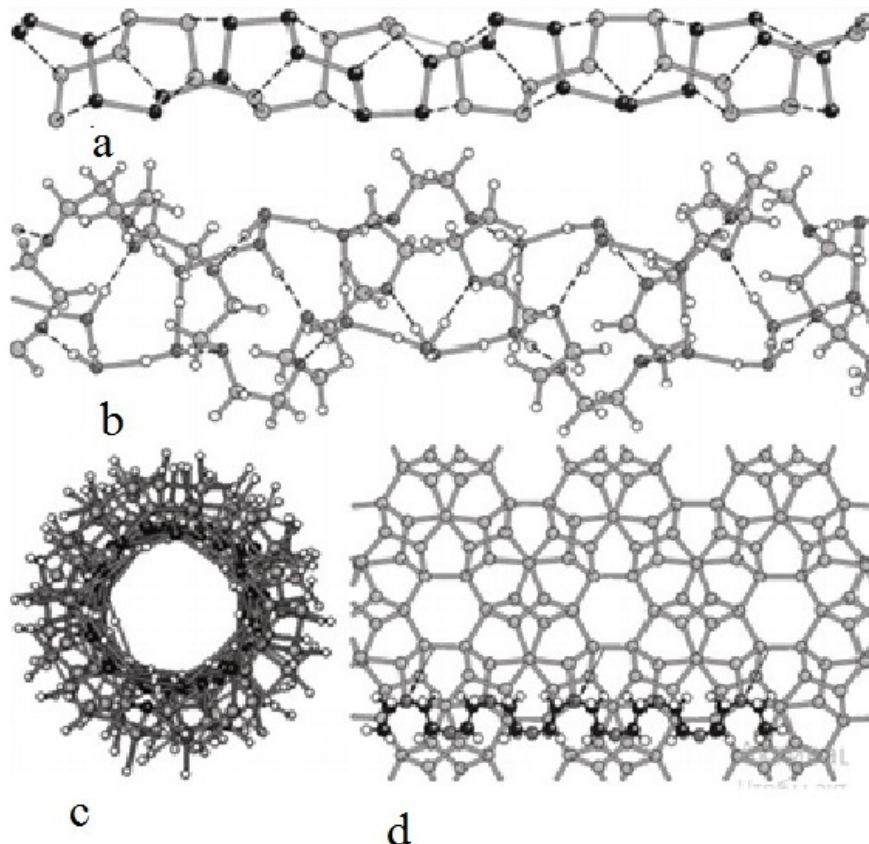


Fig. 2. Computer model of a fragment of the energy intensity of a water crystal – “30/11 helix”: a) division of the 30/11 helix into two 15/4 helices of black and gray atoms b) replacement of one 15/4 helix with a polyethylene glycol molecule; c) view perpendicular to the common axis of the spirals; d) longitudinal view of the common axis of the spirals; dotted line – hydrogen bond, solid line – covalent bond [3, 26]

The breakdown of the lattice periods of biocrystals into pseudo-periods is subject to the principle of the proportion of the golden section. Therefore, the edges of such a lattice can be structural elements of hydration shells and large-small solution biomolecules [3, 26-31, 33-36].

The most interesting and important from the point of view of complex medicine is the understanding of the fundamental point, which physical mechanisms make water and all molecules in vivo living components of one integral organism. The answer to this question lies in the essence of the phenomenon of electromagnetic interaction between water and biopolymers of a living organism. According to a number of scientists, water and biopolymers form a single energy complex at the micro level in a living organism. Biopolymers receive energy in the form of adenosine triphosphate (ATP) molecules, then, by means of their vibrations, they transform the energy of ATP into their typical coherent energy (solitons), which then moves along the chains of biopolymers and can freely and without energy loss pass to the water molecules surrounding the biopolymer. At the same time, these water molecules in a living organism are transformed into a liquid-crystalline form of energy-intensive crystals due to the fact that they constantly receive this

energy flow of specific coherent energy. These water molecules transformed into liquid crystals form a kind of water hierarchical structure in a living organism. This liquid-crystal water structure is of great physiological importance. This water chain is the physical basis for the unimpeded transfer of the flow of coherent energy from biopolymers throughout the body and performs the function of non-chemical energy interaction between molecules, linking them into a single energy whole. This phenomenon of physical information interaction between biopolymers by transferring the flow of coherent energy through the network of an aqueous liquid crystal system is a mechanism that provides information management and coordinated interaction between individual molecules of the body. For example, this mechanism can logically explain the electromagnetic role of water in the assembly and existence of the secondary and tertiary structures of proteins. Water fills the spaces between large protein molecules, since the packing of biomolecules in a crystal is loose with the formation of cavities. Water is the quantum mechanical basis for the growth of biocrystals and promotes the formation of secondary and tertiary (globular) protein structures. First, regions of the biomolecule with hydrophilic nonpolar residues tend to be shielded from the aqueous solution, while regions with hydrophilic residues tend to contact, forming hydrogen bonds and a hydration shell. Secondly, water transmits flows of coherent energy through itself, thereby participating in the creation of local electromagnetic flows and fields, which determine the necessary structural organization in the space of biomolecules. Proteins break down without water when dried, and lose their ability to be alive in vitro. Thus, it is the flows of energy moving through the molecules that make the molecules alive, cause the emergence and maintenance of water in the body in this state of liquid-crystal energy-intensive crystals. Energy-intensive fractal crystalline filamentous structures of water are supported by the energy coming from biopolymers and form large, constantly growing hierarchical structures that unite many water molecules, being in a dynamic balance between opposite processes of destruction (due to the action of chemically active substances of the cytoplasm) and the growth of branched structures, which again still determines the presence of both structured and unstructured water. The ratio between structured and unstructured parts of water in a cell depends only on the intensity of energy flows flowing in it [3, 26-28; 33-36].

We have identified the main features of the formation in living organisms of water energy-intensive fractal whisker crystals based on the "30/11 helix", such as [3, 26, 28, 37-44]:

1) water energy-intensive fractal filamentary crystals with periodically repeating elements (30/11 helices) can form even in the absence of an array of the liquid phase, with a discontinuity of the medium and under conditions under which molecules arrive at the growing crystal structure unevenly in time (this just corresponds to the actual environmental conditions of the cytoplasm of living systems);

2) at the same time, the entry/approach of water molecules (dimers) to the growing crystalline filaments turns out to be difficult in comparison with an array of pure water, and the "threads" grow in a sequence of elementary acts of attachment of new elements to the crystalline structure that are uneven in time;

3) the valence bonds of water allow the growth of side filaments of the same type 30/11;

4) volumetric parametric fractal structures of water, which are formed in this case, are extremely diverse since they are assembled according to various algorithms for interlacing groups;

5) these modular structures should be referred to as a "solid body" because of their phase state of matter (they are an ordered, long-lived structure), in connection with which they received the name "fractal crystals";

6) since the fractal water structure is a crystal and has a solid structure, its existence is not affected by the temperature of the environment (as long as energy is supplied to it, it cannot "freeze" at ordinary freezing temperatures of water or "melt");

7) structured fractal-crystalline water differs from liquid water familiar to our human senses, it does not have conductivity in its usual physical and chemical sense and fills more than 90 % of the physical bodies of living biological organisms;

8) weak hydrogen bonds unite the structural units of an energy-intensive water fractal crystal

and allow it to respond to external influences, including low-frequency electromagnetic fields, without significantly changing the structure of the system parts;

9) fractal energy-intensive water crystals are formed in the cytoplasm of living cells, are connected with biopolymers by hydrogen bonds; at the same time, for proteins, the most energetically favorable is the addition of water to the N-H group of the peptide bond of the protein;

10) a hierarchical change in the structure of already established levels under the influence of newly emerging water crystals occurs during the growth of an extended fractal crystal, which continuously occurs with the successive supply of molecules to the growing structure due to the interaction of weak bonds;

11) an energy-intensive crystal that is formed in the cytoplasm of a cell experiences a constant "attack" of chemically active impurities and can exist for a long time and even continue to grow only if it is connected to energy sources, which are biopolymers in a living cell;

12) fractal energy-intensive crystalline water systems are connected to biopolymers by hydrogen bonds and can constantly change their structure as a result of attacks by chemical impurities and exist as long as the living cell itself exists;

13) the frame structure of the 30/11 water helix is a hollow tube with an inner diameter of 3.2 nm, organized by oxygen atoms; at the same time, protons cover its inner and outer surfaces, which causes the presence of pronounced paramagnetic properties and can explain the mechanism of the occurrence of internal stress in the crystal lattice of water energy-intensive crystals of living biological systems, the effect on their behavior (orientation, direction of growth, the rate of convergence in solution, on transport they contain solitons, etc.) of the external magnetic field of the Earth;

14) a demonstrative description of the mechanisms of the influence of the Earth's magnetic field on the water fractal systems of living biological systems and on organisms in general continues to be developed by magnetobiology and still requires further experimental and theoretical studies;

15) biopolymers are capable of retaining on their surface a large number of water crystalline structures according to the number of molecules; at the same time, water structures that are not closed by molecules are capable, due to the quantum mechanical features of their structure, to carry out a long-range energy connection of bioactive molecules with their resonant partners *in vivo*;

16) water fractal energy-intensive crystals are determined in a living organism and are constantly formed in the liquid phase of water at temperatures that are significantly higher than the phase transition temperature of classical crystallization.

The conversion of ATP energy by biopolymers and its transfer to aqueous liquid-crystalline structures is probably the final stage of electromagnetic energy exchange at the tissue level, closes the metabolic energy cycle, provides the possibility of non-chemical long-range information interaction of biopolymers through this aqueous system, making tissues functionally integral and alive. A pathological process (for example, during the pathogenetic action of viruses or bacteria) can lead to disruption of energy generation and reduce its further supply in the form of solitons to tissues. This can create an energy deficit to maintain the liquid-crystalline form of water and lead in a living organism to local partial or complete destruction of the liquid-crystalline structures of water. Further gradual dissociation of non-chemical informational interaction between molecules, cells and the processes of their interaction will be a consequence of this. And this may be the beginning of the disease. The degree of violation of this interaction apparently depends on the degree of disunity of these aqueous liquid-crystalline structures and determines the pathogenesis of local energy disturbances of the microlevel of metabolism in the tissues of a living organism.

The presence of a mechanism of non-chemical energy transfer through water liquid-crystalline fractal structures can explain the chronobiological changes in the processes of interaction between biopolymers when the external magnetic field of the Earth changes. The external magnetic field of the Earth determines the orientation of water molecules and influences the resonance conditions. This can also complement the mechanism of the pathogenetic effect on living tissues

of technogenic electric and magnetic fields.

The life-supporting unique role of liquid-crystalline structures of water is most clearly described in the mechanism of tissue death upon the death of the organism. Death causes a complete cessation of energy processes that support life support. Electromagnetic processes have different parameters in different tissues, but their mechanism is universal. The fractal structures of water are not maintained in dead cells of biological systems and in *in vitro* model systems due to the lack of energy supply from external sources to molecular systems. They are destroyed completely and irrevocably at the onset of death. That is why the usual sorption of water takes place on the surface of biopolymers in the “dead” cytoplasm, while the rest of the free water mass behaves in full accordance with the ideas of chemistry about water as a solvent. The quantum mechanical phenomenology of the onset of the state of biological death at the molecular level can be described as follows from the standpoint of generalized nonlinear crystallization [3, 26-28, 45]:

1) the balance between structured and unstructured water quickly shifts towards unstructured water if a living biological system (cell) dies and, accordingly, the movement of energy in it stops; this is so due to the fact that the energy-intensive structures of water crystals disintegrate in accordance with the rate of extinction of biochemical processes in tissues;

2) the processes of stopping the movement of energy and the decay of energy-intensive water systems can be different in time (from minutes to several hours and days) for different tissues;

3) the aqueous medium (cytoplasm) of dead cells becomes an ordinary aqueous solution with a high concentration of impurities as a consequence of this, and only then does water come into contact with biopolymers, biomolecules, ions, etc. dissolved in it, and it begins to interact with their surface exclusively in accordance with the laws of sorption, hydration, chemical interactions in this “dead” cytoplasm, and forms many different chemically conditioned products, including cluster and clathrate structures, several monolayers of water in length;

4) the conductivity and dissolving ability of the cytoplasm are largely restored and all biological “anomalies” of water, characteristic of *in vivo*, practically disappear;

5) there is no energy processes in the body and life is also absent. This happens despite the fact that the molecules of biopolymers remain “in their places” and retain their structure for some time. The disintegration of fractal energy-intensive structures of water occurs after the cessation of energy processes, and the biological decay of biopolymers occurs only after this. Nothing supports the structural connection of the biological system after the disappearance of energy biochemical and control energy flows and chaotic uncontrolled chemical reactions begin between substances. A biological system without the occurrence of magnetoelectrochemical processes is transformed from a living into a dead one – it becomes a set of molecules in its essence.

Thus, the key water in the implementation of electromagnetic processes to the phenomenon of life of living biological organisms lies in the fact that water becomes the physical basis for non-chemical energy interaction between biopolymers, cells, tissues of a living organism, and combines it into a single functional and bodily integrity. And this happens due to the fact that water is able to take the form of liquid energy-intensive crystals in living biological systems. This liquid-crystalline state provides unique anomalous physical properties of water to living organisms.

G. Ling considered the fact of water binding by biopolymers to be the most important parameter in molecular biochemistry and argued that not taking into account the role of the aquatic environment and the resulting erroneous interpretation of the functions of cell organelles and cell cytoplasm lead biology to inevitable collapse. The idea of “connectedness” of water has been recognized by many biologists. E. Bauer wrote about the liquid medium of the cell as a colloidal aqueous solution and called biomolecules with an ordered distribution of water molecules in the boundary layer “living matter” in his book *Theoretical Biology*. N. Nasonov, A. S. Troshin, A. Szent-Gyorgyi, G. Ling, E. Gudichi and V. Voeikov proposed various models of water “binding” near the surface of biomolecules. J. Pollack proposed the idea of cytoplasm in the form of bound water and described it as a gel, in which the boundness is determined by physical adsorption on the surface of biopolymers, and all protein conformations occur due to changes in

the physicochemical properties of this gel. G. Ling proposed a mechanism for binding water through the electrical properties of its dipoles, etc. However, the physical mechanisms of the process of “binding” water remained undeveloped. This was an obstacle to further advancement of the idea in the fundamental natural science of the corresponding historical period [3, 34, 46-52].

The description of modern physical and chemical data presented in the article on the role of water in the electromagnetic processes of the phenomenon of life of living organisms and humans sums up this scientific research on this issue. These modern data on the liquid-crystalline energy-intensive form of water in living organisms open up a fundamentally new view on the energetics of the cellular level of metabolism in living biological systems. These modern water data complement and do not contradict existing scientific knowledge.

4. Conclusions

The following conclusions can be drawn on the basis of the results of the theoretical study:

1) The “30/11 helix” is the main most typical fragmentary element of water self-organization into fractal structures and it forms energy-intensive fractal crystalline filamentous water structures in living biological systems, supported by energy constantly coming from biopolymers, and forming large constantly growing hierarchical structures that unite all the water of a living organism in a dynamic balance of opposite processes of destruction and growth of its energy-intensive crystalline structures.

2) Water has a key role in the process of transmission and perception of the coherent energy of a soliton through self-organizing fractal energy-intensive paramagnetic crystalline structures in living biological systems.

3) The phenomenon of biological life at the micro level is characterized by the presence of a state of water binding/organization into energy-intensive crystalline structures due to the constant supply of coherent energy from biopolymers and stops when this energy flow disappears, which corresponds to the onset of the phenomenon of biological death and is manifested by the degradation of energy-intensive fractal crystalline self-organization of water to an unbound water state. Solution devoid of so-called biological anomalies.

The practical significance of the results obtained lies in the fact that knowledge and understanding of the quantum mechanical features of the structure of water and the role of water in the electromagnetic processes of the phenomenon of life at the microlevel of the structure of living organisms is the next step towards deepening fundamental knowledge about the pathogenesis of diseases of internal organs. Modern deepening of fundamental knowledge to the level of magnetoelectric processes of the molecular level in living biological systems should be integrated into medical science with the change of the electrochemical metabolism paradigm to the magnetochemical metabolism paradigm. Deepening knowledge about the role of water in the implementation of electromagnetic processes in living organisms can become the basis for further development of knowledge in nephrology as well.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions

Ozar P. Mintser: critical review, final approval of the article. Maksim M. Potiazhenko: critical review, final approval of the article. Inga B. Bumblytè: critical review, final approval of the article. Ganna V. Nevoit: work concept and design, data collection and analysis, writing the article.

Conflict of interest

The authors declare that they have no conflict of interest.

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