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BIOPHOTONICS AND REFLEXOLOGY: CONCEPTUALIZATION OF THE ROLE OF BIOPHOTONIC SIGNALING

Relevance. The theoretical research was carried out in order to create a biological medical theory that could conceptually describe the substrate and mechanisms of transmission of the therapeutic effect of reflexology through biologically active points and resolve the scientific paradox regarding the existence of the primary vascular system. This is an urgent problem for modern fundamental science and medicine in order to replenish scientific knowledge, further medical progress and understand the mechanisms of effectiveness

of traditional medicine and reflexology according to the resolutions of the Gujarat Declaration of the Traditional Medicine Global Summit 2023 meeting report.

The aim of this study is to conceptualize modern ideas about the role of biophotons/biophoton signaling in the implementation of reflex connections between organs through energy channels in the human body, which are defined in traditional medicine as meridians.

Materials and methods. general scientific and theoretical methods were used during the theoretical research.

Results. A working concept of the participation of biophoton signaling mechanisms in intercellular communication and reflex interaction between tissues, organs and segments of the human body was developed.

Conclusions. 1. At the nano-level, biophoton signaling is an important electromagnetic mechanism of intercellular communication, which ensures the information transfer of genetic information from DNA molecules to all molecules and cells of the body, participates in the creation of biological electromagnetic fields at all hierarchical levels and provides the electromagnetic basis of the phenomenon of life. 2. At the level of the organism, biophotonic signaling is an important part of energy exchange in the human body and ensures the implementation of reflex connections between organs through myofascial connections and the primary vascular system, which topographically correspond to the meridian system of traditional medicine. 3. The primary vascular system is a new anatomical system that is fundamentally different from the circulatory system and the lymphatic system of the human body, which is histomorphologically adapted to transmit the electromagnetic biophoton signal according to the optical fiber principle at the speed of light and is the morphological substrate of the meridian system of traditional medicine. 4. The concept of biophoton signaling complements modern ideas about energy exchange in the human body, does not contradict them, logically substantiates the participation in the processes of transmission of electromagnetic energy of the primary vascular system and explains the fundamental aspects of the role of electromagnetic processes in the realization of the phenomenon of human life.

Key words: biophotons, biophoton signaling, meridians, primary vascular system, traditional medicine, reflexology, non-communicable disease.

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БІОФОТОНІ І РЕФЛЕКСОТЕРАПІЯ: КОНЦЕПТУАЛІЗАЦІЯ РОЛІ БІОФОТОННОГО СИГНАЛІНГУ

Актуальність. Теоретичне дослідження було виконано задля створення біологічної медичної теорії, яка б могла би концептуально описати субстрат і механізми передачі терапевтичного впливу рефлексотерапії через біологічно активні точки й вирішити науковий парадокс щодо існування первинної судинної системи. Зазначене є актуальною проблемою для сучасної фундаментальної науки і медицини задля поповнення наукових знань, подальшого медичного прогресу і розуміння механізмів ефективності традиційної медицини та рефлексотерапії згідно з постановами Гуджаратської декларації Глобального саміту традиційної медицини 2023 р.

Мета дослідження – концептуалізувати сучасні уявлення щодо ролі біофотонів/біофотонного сигналінгу у реалізації рефлексотерапії зв'язків між органами через енергетичні канали в організмі людини, які визначаються у традиційній медицині як меридіани.

Матеріал і методи. Під час виконання теоретичного дослідження використано загальнонаукові і теоретичні методи.

Результати дослідження. Розроблено робочий концепт участі механізмів біофотонного сигналінгу у міжклітинній комунікації та у рефлексотерапії взаємодії між тканинами, органами і сегментами тіла людини.

Висновок.

1. На нанорівні біофотонний сигналінг є важливим електромагнітним механізмом міжклітинної комунікації, який забезпечує інформаційну передачу генетичної інформації від молекул ДНК до всіх молекул і клітин тіла, бере участь у створенні біологічних електромагнітних полів на всіх ієрархічних рівнях та забезпечує електромагнітну основу феномену життя.

2. На рівні організму біофотонний сигналінг є важливою частиною енергетичного обміну в тілі людини і забезпечує реалізацію рефлексотерапії зв'язків між органами через міофасціальні зв'язки та первинну судинну систему, які топографічно відповідають системі меридіанів традиційної медицини.

3. Первинна судинна система є новою анатомічною системою, яка принципово відрізняється від кровоносної системи та лімфатичної системи організму людини, яка гістоморфологічно пристосована для передачі електромагнітного біофотонного сигналу за оптоволоконним принципом зі швидкістю світла і є морфологічним субстратом системи меридіанів традиційної медицини.

4. Концепція біофотонного сигналінгу доповнює сучасні уявлення про енергетичний обмін у тілі людини, не суперечить їм, логічно об'єднує участь у процесах передачі електромагнітної енергії первинної судинної системи та пояснює фундаментальні аспекти ролі електромагнітних процесів у реалізації феномену життя людини.

Ключові слова: біофотони, біофотонний сигналінг, меридіани, первинна судинна система, традиційна медицина, рефлексотерапія, неінфекційні захворювання.

Introduction. It is well known that the use of reflexology methods in the complex treatment of chronic non-communicable disease (NCDs) significantly increases efficiency and brings good results (Whatley et al., 2022; Cai et al., 2022; Runge et al., 2022; Zaina et al., 2023). Therefore, an urgent task for modern medicine is to further study the fundamental issues of the mechanisms for realizing the therapeutic effects of reflexology.

However, today in modern medicine a paradox has arisen regarding the issue of full recognition of the existence in the human body of a three-dimensional system of “energy channels/meridians” and “biologically active points/acupuncture points.” These scientific concepts have been used empirically for many hundreds of years by Western medicine due to the clinical effectiveness of the techniques (Jing & Wen, 1963; Dorfer et al., 1998, pp.

242–243; Dorfer et al., 1999, pp. 1023–1025; Schnorrenberger, 1996, 2005, 2008; Potyazhenko, & Nevoit, 2019). In 1960, Korean scientist Kim Bong-Han described a new anatomical system that corresponded to the ancient acupuncture meridians. The results were presented in four reports and published as two books in English (Kim, 1962, 1963, pp. 6–35, pp. 1–41, 1964, 1965, pp. 1–38, pp. 1–6, pp. 39–62). Many scientists have shown scientific interest in these ideas (Kellner G., 1966; Fujiwara, & Yu, 1967; Soh et al., 2011). This was perceived by the scientific world community as a hypothesis that does not have sufficient evidence. In 2002, Dr. Kwang-Sup Soh's research team carried out a new independent study of the anatomical system that Bong-Han described and confirmed its existence (Soh, 2009; Soh et al., 2011; Soh et al., 2013). The new anatomical structure is called the Primary Vas-

cular System (PVS). A new uniform terminology was developed. This was approved at the first International Symposium on the Primary Vascular System (Jecheon, Korea) (Soh et al., 2013). Fundamental research by Dr. Kwang-Sup Soh's group was carried out at a high level from the standpoint of evidence-based medicine and published in specialized scientific journals that publish articles on acupuncture. All results concerning the PVS have been published in international scientific journals such as *New Journal of Physics*; *PLoS One*; *Anatomical Record Part B: The New Anatomist*; *Microscopy Research and Technique*; *Current Applied Physics*; *Naturwissenschaften*; *Lymphatic Research and Biology*; *Applied Physics Letters*; *Journal of Biomedical Optics*; *Microcirculation*; *Cardiology*; *Lymphology*; *Journal of Health Science*; *Biologia*; and *Journal of International Society of Life Information Science* (Vodyanoy et al., 2015). This has revived scientific interest in PVS. But full scientific recognition of the existence of PVS has not occurred. Today, there is proven fundamental knowledge about the anatomy and morphology of PVS, the functioning of PVS, and the histochemistry of PVS (Kim, 2022; Kang, 2016, 2022). This knowledge remains not integrated into orthodox medicine. Knowledge about PVS is not included in textbooks on physiology and anatomy. PVS research is continued only by scientists who use the knowledge of traditional medicine. This is a paradox in science that we must try to overcome (Kang, 2016, 2022; Stefanov, 2022). Perhaps data on the existence and functioning of PVS are ignored by many scientists because science does not yet have a modern, logical biomedical concept to explain the existence of PVS. Science needs a biological medical theory that can describe the substrate and mechanisms of therapeutic transmission through biologically active points/acupuncture points and PVS. This theory would provide the basis for linking the existing scientific paradigm with new data on PVS. Then the existence of PVS and its functions in the human body could be included in the scientific paradigm of medicine. Therefore, theoretical research to achieve this goal is relevant and important for fundamental science and medicine.

For modern science, understanding the essence and meaning of traditional medicine and reflexology is absolutely important. This was reflected in the conclusions of the World Health Organization at the “Traditional Medicine Global Summit 2023 meeting report: Gujarat Declaration”. According to paragraph 12 of the Gujarat Declaration, it is necessary to use science, technology, innovation and knowledge sharing to confirm and disclose the feasibility of traditional medicine. According to paragraph 14 of the Gujarat Declaration, it is also necessary to contribute to the development, implementation, monitoring, and

transformative impact of the WHO Global Traditional Medicine Strategy for the period 2025-2034, and advocate for increased political and financial commitments at global, regional, national and community levels to translate that strategy into policies and practices for people's health and well-being (WHO, 2023).

Therefore, it is necessary to develop a biomedical theory that can describe the substrate and mechanisms of transfer of therapeutic effects through biologically active points/acupuncture points and PVS. To achieve this, this theoretical study carried out a conceptualization of modern ideas about the role of biophotons in the implementation of reflex connections between organs along energy channels in the human body, called meridians in traditional medicine.

Materials and methods. This theoretical study is part of the educational, research project “Bioelectronic Medicine”. This 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 NCDs based on the study of functional status” (state registration number 0121U108237). The theoretical study was carried out by a transdisciplinary team of scientists and doctors from Poltava State Medical University, Shpyk National Healthcare University of Ukraine and Lithuanian University of Health Sciences in accordance with concluded memorandums of cooperation. Doctor O. Filynova took part in the research as an initiative researcher-applicant. 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.

Results. The result of this fragment of theoretical research was the creation of a working concept of a biological medical theory that could describe the substrate and mechanisms of transmission of therapeutic effects through biologically active points/acupuncture points and PVS. The basis for this was the combination of existing medical and biophysical knowledge about the role of biophotons in the human body with the ideas of traditional medicine and reflexology about the existence of the meridian/PVS system. Based on the performed system analysis of existing scientific knowledge, the concept of biophotonic signaling was developed. It can be described in a simplified form in such a conceptual model (fig. 1).

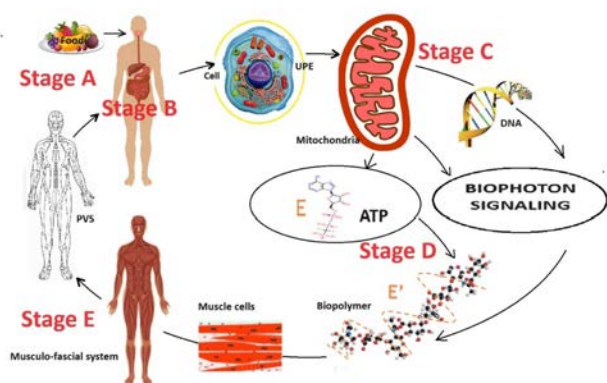


Fig. 1. Scheme of energy metabolism in the human body showing the participation of biophotonic signaling

Note: E is the incoherent energy of adenosine triphosphate (ATP). E' is the coherent energy that is formed by the biopolymer. The dotted line on the biopolymer indicates the oscillatory processes of the biopolymer. Stage A is the entry of energy in the form of food into the human body. Stage B is the digestion of food, the assimilation of food substrates, their entry into the blood and cells of the human body. Stage C corresponds to the processes of ultraweak photon emission (UPE) and tissue respiration in the cell, which lead to the formation of biophotons and the ATP molecule, respectively. Stage D occurs on membrane biopolymers (mainly striated muscles) and ensures the transformation of the biochemical energy of the ATP molecule into electromagnetic energy. Stage E is the redistribution and transport of electromagnetic energy from muscles to other parts of the human body along myofascial connections (tendon meridians) and PVS.

It should be noted that knowledge about the role of biophotons in the human body is the basis of the concept of biophoton signaling. Knowledge about biophotons in the human body is a fundamentally new milestone in the scientific understanding of the mechanisms of energy and information interaction between cells of the human body at all levels of its structural hierarchical organization *in vivo* (Van Wijk, & Shen, 2005; Cifra et al., 2011; Mintser et al., 2021, 2023). Biophotons are a component of electromagnetic signaling. Biophotons perform fundamentally important functions in the transfer of information and energy between tissues, in the processes of visual perception and in higher nervous activity as well (fig. 2) (Kobayashi & Inaba, 2000; VanWijk, 2001; Nevoit et al., 2023, pp. 1–15; Mintser et al., 2020, pp. 1279–1283).

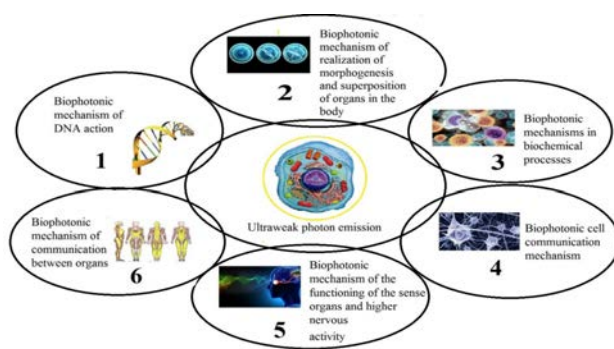


Fig. 2. Key functions of biophotons

Biophotons and their emission processes have been studied in many biological species of living organisms (fungi, plants, etc.) (Madl, 2006; Yip, & Madl, 2006) and in humans (Popp et al., 1992; Chang et al., 1998.; VanWijk, 2001; Popp, 2005; Yip, & Madl, 2006; Bischof, 2008; Niggli, 2014). The study of biophotons in normal (Cifra et al., 2007; M. Kobayashi et al., 2009; R. Van Wijk, 2014; Salari et al., 2015; Tinsley et al., 2016; Kobayashi et al., 2016; Van Wijk et al., 2020, p. 770; Nevoit, et al., 2020, pp. 107–111) and pathological conditions (Niggli et al., 2008, pp. 358–363; Van Wijk, et al., 2013, pp. e84579; Kumar et al., 2016, pp. 00134; Usui et al., 2019; Zapata et al., 2021; Tsuchida, & Kobayashi, 2020; Nevoit et al., 2021, pp. 1439–1444; Sun et al., 2017) in humans is currently ongoing. According to the new concept, biophotons are electromagnetic information carriers. They carry information from genes about how exactly metabolic processes in the cell should proceed, etc. Biophotons transmit this information at the speed of light. Therefore, biophoton signaling mechanisms may explain the rapid simultaneous coordination of metabolism throughout the human body.

It has been established that biophotons carry information and 75% of biophotons in a cell are generated in DNA molecules (Popp et al., 1984, pp. 33–52; VanWijk, 2001; Scaletta et al., 2001; Popp, 2006; Levin, 2014, 2021; Nevoit et al., 2023, pp. 1–15). Where is DNA found in a cell? It is known that DNA is contained in the cell nucleus and mitochondria. This is important because mitochondrial DNA also emits biophotons and determines the biophoton mechanisms of intracellular and intercellular signaling. The DNA content in mitochondria is very significant due to the fact that normally each cell can contain up to several thousand mitochondria. Mitochondria are an important organelle for energy production and they make up up to 10% of the dry mass of the cell (Malina et al., 2021;

Casanova et al., 2023). Thus, it becomes logical and clear that it is nuclear DNA and mitochondrial DNA that are the main sources of UPE/biophoton signaling (stage C, fig. 1). It is logical that a somatic cell, depending on the type of tissue, contains one nucleus, but may contain a different number of mitochondria. Therefore, the quantitative contribution of cells of different tissues to biophoton signaling should differ.

What is the further path of emitted biophotons in a cell *in vivo*? Based on a systematic scientific analysis, it was found that biopolymers of membrane structures are the next stage of biophotonic signaling (stage G, fig. 1). Biopolymers receive electromagnetic information from the cell nucleus and mitochondria in the form of biophotons and, based on it, create the parameters of the coherent energy they generate. It is well known that cells have electromagnetic fields that are generated by the membrane structures of the cells. At the nanoscale, this process is realized due to the oscillation of membrane biopolymers. Biopolymer molecules containing anhydride radicals oscillate, converting incoherent energy obtained from adenosine triphosphate molecules into coherent energy (Mintser et al., 2021, 2023). This is stage G (fig. 1). It is important to understand that the coherent energy formed by biopolymers receives information content from the DNA of the cell thanks to biophotonic signaling and forms the electromagnetic field of the cell (biological morphogenetic field).

Vibrations of biopolymers create coherent energy. This coherent energy has information content from DNA. It must be transmitted further in the cell and in the tissues of the human body. How does this happen? In the course of a systematic scientific analysis, it was found that electromagnetic coherent biophonic flux/solitons can be transmitted in two main ways.

The first way of transmitting biophoton signaling is the transition of the flow of electromagnetic coherent biophoton energy/solitons from biopolymers of membrane structures to water molecules. It has been established that under the influence of this energy flow, water molecules are structured into energy-intensive liquid crystals. These crystals have a 31/21 spiral shape (Mintser et al., 2021; Nevoit et al., 2022, pp. 45–57). At the same time, water loses its fluidity and acquires special properties of electrical conductivity, which explain the presence of biological anomalies in water *in vivo*. This makes it possible for coherent energy to be transported through the water structures of the cellular and intercellular spaces without loss (Mintser et al., 2021, 2023). Thus, the biophysical role of water in the human body is explained by its participation in the transmission of electromagnetic biophoton signaling as well.

The second way is the possible transfer of energy and information by biophotons to the biopolymers of the membrane structures of other cells. According to modern biophysical concepts, cell membrane lipoproteins are found in membranes in a state of liquid crystals (Nevoit, 2021; Mintser et al., 2021; Nevoit et al., 2022, pp. 22–34). This also creates conditions for the transmission of electromagnetic signals in cell membranes. Different tissues/membrane biopolymers of different cell types have different quantum mechanical structures. Therefore, they can generate and conduct electromagnetic signals in different ways. Modern biophysical knowledge (Huang et al., 2016; Bordoni, & Simonelli, 2018; Binhi, & Rubin, 2022; Li et al., 2023) allows us to consider the connective tissue of the body as a morphological substrate that can perform adequate translation of the electromagnetic signal flow along throughout the body. This is justified by the fact that the features of the histomorphological structure of connective tissue cells allow them to be semiconductors. Under certain conditions, they can effectively transmit an electromagnetic signal between cells, between tissues, between organs and throughout the body.

What is the contribution of cells of different tissues of the human body to biophotonic signaling? It is clear that each somatic cell contains one nucleus, but the content of mitochondria in cells can vary depending on the type of tissue. Therefore, the cell's contribution to biophoton signaling can also be different. The more mitochondria there are, the larger it will be. Which tissues of the human body contain the largest number of mitochondria? Of course, these are tissues with a high metabolic rate. Brain cells and striated muscles contain the largest number of mitochondria – 22% (McClave & Snider, 2001; Park et al., 2014; Song et al., 2024). In this case, the contribution to the general biophoton signaling of the human body will be greater from an organ that has a large mass, provided that the content and activity of mitochondria are the same. The mass of the human brain ranges from 1100 g to 1900. The mass of muscle tissue in an adult on average should be up to 40% or up to 50% of the total body weight, depending on age. The muscle mass in the body of a healthy, physically developed person weighing 70 kg should be about 30–35 kg. Thus, it is quite logical to believe that the total contribution of muscles to biophotonic signaling should significantly exceed the contribution of brain cells. Of course, the qualitative contribution of the generation of biophotonic signaling from neurons and from striated muscles should be fundamentally different. It can be assumed that the information that is included in the biophoton signaling coming from neurons is qualitatively different and it spreads,

most likely, to a greater extent throughout the nervous system of the body. How can electromagnetic standing waves/solitons of biophotonic signaling propagate from muscle cells? And what biological significance does this biophoton signaling from muscles have?

The semiconductor properties of connective tissue fit very logically into the presentation of the physical and biological description of the mechanisms of transmission of electromagnetic energy, which is formed during the contraction of striated muscles (stage D fig. 1). It is important to understand that muscle activity and the energy generated in the muscles is intended to provide the energy needs of the entire body as a whole. This is the biological meaning of physical activity for the functioning of the body. It is well known that regular physical activity provides an energizing effect on the human body (San-Millán, 2023). Physical inactivity and immobility have a negative impact on the metabolism and functional state of the human body (Nevoit et al., 2021, pp. 132–137). A decrease in the amount of muscle tissue leads to a deterioration in the provision of energy metabolism processes throughout the body (Chen et al., 2023; Always et al., 2023). This is confirmed by the results of studies analyzing electrophoton emission in patients with NCDs and functionally healthy people (Nevoit et al., 2021, pp. 1439–1444).

Regular physical activity increases the overall energy requirements of the human body. This leads to the fact that the mitochondrial content increases in myocytes with regular training and mitochondria can become hypertrophied (McTiernan et al., 2019; Gremminger et al., 2021). Thus, it is very important to understand the fact that it is in the myocytes of striated muscles that the final stage of the body's energy metabolism occurs: energy consumption/utilization. The biological role of muscles is to participate in the final stage of metabolism and ensure the processing of the ATP molecule as the final chemical carrier of energy into electromagnetic energy (stage E, fig. 1). Then, according to the fundamental laws of physics, electromagnetic energy is transformed by the cells of the human body into other types of energy: mechanical energy (body movement), thermal energy (infrared radiation of the body), acoustic energy (wave processes in the body in the frequency range that is perceived by humans as sound), etc.

How can the electromagnetic energy of biophotonic signaling be transmitted throughout the body? Carrying out its key biological role of providing energy to the body, the striated muscles of the human body produce electromagnetic energy. The amount of this generated energy exceeds the energy needs of the local muscles in which it was produced. It is quite logical that at the

level of the body there should be systems for transferring this energy to other parts of the body, to other cells and redistributing energy between them. Therefore, the fascial system and myofascial synkinesis are ideal candidates for this role due to the semiconductor properties of connective tissue. The correctness of this concept is confirmed by many studies that demonstrate the coincidence of the course of ancient eastern meridians with certain muscle chains. These chains have been called myofascial synkinesis or “muscle trains” (Myers, 2020; Guntinas-Lichius et al., 2022).

Connective tissue also has a very diverse histomorphological presentation in the body and the representation of mesenchymal cells of different structures in tissues and organs. Therefore, fascial theory alone cannot explain all the nuances of the possible transfer of energy along the meridian system. In particular, it does not fully explain the presence of biologically active points on the skin with a direct connection to specific organs (key points) (Stefanov, 2022), etc.

As already noted, the existence of energy channels/meridians is scientifically proven. Energy channels have been repeatedly visualized (Stefanov, & Kim, 2015; Potyazhenko & Nevoit, 2019; Zhang et al., 2008). The discovery and proof of the fact of their existence took over half a century. Now in science, the histological structures of the energy channels of the human body have received the status of a separate system, which was called the primary vascular system (PVS) (Stefanov et al., 2013). What is the role of PVS in the transmission of biophotonic signaling in the human body?

Plants (Okabe, 2024), animals, and humans (Stefanov et al., 2013) have PVS. The mammalian PVS has an extensive vascular system that is fundamentally different in structure and function from the circulatory and lymphatic vascular systems. Based on existing scientific evidence, we have made the following simplified conceptual description of PVS.

PVS is localized throughout the body on the surface and inside all organs, blood and lymphatic vessels, in the internal and peripheral nervous system, and in the skin. Anatomically, the PVS has two main structural elements: primo-vessels and primo-nodes. A primo vessel is a bundle of 1–20 subvessels with a diameter of 3–25 μm , which are surrounded by an outer shell. The primo-nodes are elements of various shapes (round, oval or polyhedral) with a diameter of 0.1–1.6 mm. The node includes a bundle of incoming (afferent) vessels, which branches into additional bundles and fills the inside of the node with tightly twisted and folded bundles. The subvessels converge and exit the node as efferent primordial vessels. The expanded subvessels inside the

node are the sinuses of the node and they carry microelements – the precursors of multipotent stem cells. Rows of primo-nodes and vessels form a system that consists of a large number of channels. Each channel is associated with a separate organ. Moreover, some authorities may have connections with a different number of channels. The channel may start from a superficial node; then, after connecting in series with several deep nodes, it connects to the intraorgan terminal node and is then closed by a channel returning to the superficial node. The canals are filled with fluid that transports precursors to multipotent stem cells (microcells), hormones, amino acids, lipids, sugars, proteins and hyaluronic acid. Progenitor stem cells develop into multipotent stem cells in the sinus nodes. After entering an internal organ, they differentiate into new organ-specific cells. In turn, aged (or damaged) organ cells are converted into microelements. The PVS circulates a fluid that has been called «primo fluid». Its flow is slower than blood flow and lymphatic flow. The primary fluid flows in one direction, accompanying the blood flow. Fluid flow depends on heart rate and pressure, blood and lymph. PVS fluid contains DNA outside the cell nucleus. The biochemical components of Primo fluids are DNA, RNA, nitrogen, fats, reducing sugars, hyaluronic acid, 19 free amino acids and 16 free mononucleotides. The flow routes are interconnected but relatively independent. Primo fluid circulates only in a specific area, but it can also be transmitted through connections to other routes. Primo vessels consist of endothelial cells with rod-shaped nuclei, smooth muscle cells and adventitia. Subvessels contain fibrous structures and amorphous substances. The membrane surrounds the entire primo vessel (Kwon et al., 2012; Lee et al., 2007; Kim et al., 2011; Lee et al., 2004; Hossein et al., 2011; Scholkmann et al., 2019).

Of interest to science are the results of a study of the role of PVS in the transmission of electromagnetic signals in the human body (stage E, fig. 1). Stimulation of the superficial PVS nodes using acupuncture or osteopathic manipulative techniques has been found to send electrical signals, hormones, and multipotent stem cells to the associated organ. These mediators support organ stimulation and regeneration (Schlebusch et al., 2005). The structure of PVS vessels resembles the operating principles of optical fiber. The PVS functions as an optical channel for the emission of biophotons. Free DNA in primo liquid can act as both a photon store and a coherent emitter. Bioelectric signals of PVS endothelial cells are similar to those of smooth muscle cells (Park, 2009). All primo-vessels have a collagen shell, which prevents the emission of photons emanating from biomolecular sources (Stefanov, 2012). This property of collagen

makes it easier to tune photon emission throughout the body (Kim et al., 2007). This confirms the fact that metabolism is regulated by the photon field (Soh et al., 2011). Therefore, it is now generally accepted that PVS is a photovoltaic system for the rapid transmission of an electromagnetic biophotonic signal, in which biophotonic signaling occurs at the speed of light. This explains the immediate effect throughout the human body after puncture of acupuncture points (Lee et al., 2006; Kwon et al., 2007; Soh et al., 2004, pp. 1196e1198.; Lee et al., 2011, pp. 1e7).

Thus, PVS is the missing link that explains the mechanisms of action of reflexology through trigger biological active points / “key points to the organ” and the final stage of the transfer of electromagnetic energy throughout the human body. Therefore, in fig. 1, stage E corresponds to the processes of distribution of coherent electromagnetic biophoton energy in the human body along the fascial system and PVS. In our proposed working concept of the model, the main source of biophotonic signaling is muscle tissue, and it is this tissue that is presented in this diagram when describing stage E.

Discussion. The concept of biophotonic signaling we presented is a significant addition to existing medical knowledge. The concept of biophotonic signaling fills a theoretical gap in the understanding of many fundamental issues in the functioning of the human body regarding the fact of how exactly information from DNA can be conveyed to each molecule *in vivo*. Biophotonic signaling is a flow of electromagnetic biological signals from DNA that shapes and adjusts metabolic processes and cell development in various parts of the body. Therefore, the concept of biophotonic signaling logically explains the mechanism of formation of the biological morphogenetic field, thanks to the electromagnetic influence of which the processes of differentiation, development and completion of the life cycle of cells occur. For example, thanks to the biophotonic mechanism of cell communication, a stem cell or a newly emerged cell during division will fall into this local electromagnetic field of cells in a region of body tissue, and they will receive information from it for their metabolism and development. Thus, the molecules of all cells *in vivo* receive regulatory information through electromagnetic biophotonic signaling, which controls their development and metabolism. This is the biological significance of biophoton signaling for cell life *in vivo*. Thanks to biophotonic mechanisms, important information from DNA that determines the course of metabolic reactions can reach other cellular structures at the speed of light. For example, into cell biopolymers, which are localized in the membrane structures of the cell. Therefore, the concept of biopho-

tonic signaling explains the mechanisms of simultaneous coordination of many biochemical reactions that constantly occur in the cells of the human body. At the same time, the concept of biophotonic signaling does not contradict the existing knowledge of orthodox medicine, but it is built on their basis and organically fits into the existing scientific paradigm, complementing it.

Within the framework of the goals of the World Health Organization to study the mechanisms of effectiveness of traditional medicine and reflexology, the concept of biophotonic signaling is the link that combines the existing knowledge of traditional medicine and reflexology about the existence of energy channels and the movement of energy throughout the body with the ideas of orthodox medicine about metabolism in the human body. This concept describes the final stage of energy metabolism, which consists in the transformation of incoherent energy, the carrier of which is the ATP molecule, into coherent energy formed by biopolymers of the membranes of human body cells. Biophotonic signaling mechanisms from DNA molecules fill the information component of this energy formed by biopolymers. This energy is then transferred through biopolymers and water clusters at the cell level. At the body level, the movement of this energy occurs through the fascial system of the body and through the channels of the PVS.

Conclusions

1. At the nano-level, biophoton signaling is an important electromagnetic mechanism of intercellular communication, which ensures the information transfer of genetic information from DNA molecules

to all molecules and cells of the body, participates in the creation of biological electromagnetic fields at all hierarchical levels and provides the electromagnetic basis of the phenomenon of life.

2. At the level of the organism, biophotonic signaling is an important part of energy exchange in the human body and ensures the implementation of reflex connections between organs through myofascial connections and the primary vascular system, which topographically correspond to the meridian system of traditional medicine.

3. The primary vascular system is a new anatomical system that is fundamentally different from the circulatory system and the lymphatic system of the human body, which is histomorphologically adapted to transmit the electromagnetic biophoton signal according to the optical fiber principle at the speed of light and is the morphological substrate of the meridian system of traditional medicine.

4. The concept of biophoton signaling complements modern ideas about energy exchange in the human body, does not contradict them, logically substantiates the participation in the processes of transmission of electromagnetic energy of the primary vascular system and explains the fundamental aspects of the role of electromagnetic processes in the realization of the phenomenon of human life.

Biophotonics of the human body and the study of the role of biophotons are promising directions for further scientific research. Research to further clarify the role of the primary vascular system in the functioning of the human body and its individual organs should be continued.

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