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MECHANISMS OF PRIMARY RECEPTION OF ELECTROMAGNETIC WAVES OF OPTICAL RANGE AS A BIOPHYSICAL BASIS OF POLARIZED LIGHT THERAPY

S. O. Hulyar

International Medical Innovation Center ZEPTER

An existence of separate functional system of electromagnetic balance regulation has been substantiated and a working conception of light puncture has been formulated. As a basis, there is a possibility to use the acupuncture points for input of biologically necessary electromagnetic waves into the system of their conductors in a body that might be considered as a transport facility for energy ofthe polarized electromagnetic waves. Zones-recipients are organs having an electromagnetic disbalance due to excess of biologically inadequate radiation and being the targets for peroxide oxidation, foremost, a body has the neurohormonal and immune regulatory systems. Electromagnetic stimulation or modification of functions of the zones-recipients determines achievement of therapeutic and useful effects, and their combination with local reparative processes allows attaining a clinical goal. We represent own and literary experimental data about development of physiological responses (analgesia, bronchospasm control, immune stimulation and inhibition of peroxide oxidation of lipids) to BIOPTRON-light exposure on the acupuncture points or biologically active zones. We show the experimental facts in support of a hypothesis that a living organism can perceive an action of the electromagnetic waves of optical range not only via the visual system, but also through the off-nerve receptors (specific energy-sensitive proteins detecting critical changes of energy in cells and functioning as the "sensory" cell systems), as well as via the acupuncture points. This confirms an important role of the electromagnetic waves of optical range in providing normal vital functions of living organisms. A current approach to BIOPTRON light therapy consists in combined (local and system) exposure of the electromagnetic waves within the biologically necessary range.

Key words: acupuncture points, light puncture, polarized electromagnetic waves, off-nerve receptors, pain, PILER, HSP-proteins, PAS-proteins, BIOPTRON, photoreceptors.

МЕХАНІЗМИ ПЕРВІСНОЇ РЕЦЕПЦІЇ ЕЛЕКТРОМАГНІТНИХ ХВИЛЬ ОПТИЧНОГО ДІАПАЗОНУ ЯК БІОФІЗИЧНА ОСНОВА ТЕРАПІЇ ПОЛЯРИЗОВАНИМ СВІТЛОМ

С. О. Гуляр

Міжнародний медичний центр інновацій ZEPTER

Обґрунтовано існування окремої функціональної системи регуляції електромагнітного балансу організму та сформульована робоча концепція світлотерапії. В її основу покладена можливість використання точок акупунктури для введення біологічно необхідних електромагнітних хвиль до системи шляхів їх проведення у організмі, яка може бути розглянута як засіб транспорту енергії поляризованих електромагнітних хвиль оптичного діапазону. Зонами-реципієнтами є органи, що мають електромагнітний дисбаланс у зв'язку з надлишком біологічно неадекватних випромінювань та є мішенню для перекисного окиснення, насамперед, нейрогормональна та імунна регуляторні системи. Електромагнітна стимуляція або модифікація функцій зон-реципієнтів зумовлює отримання лікувального і корисного ефектів, комбінація яких з місцевими репаративними процесами дозволяє домогтися клінічної мети. Наведені власні та літературні дані про розвиток фізіологічних реакцій у відповідь на дію БІОПТРОН-світла на точки акупунктури. Наведені експериментальні факти, що підтверджують припущення про те, що живий організм здатний сприймати дію електромагнітних полів оптичного діапазону не тільки крізь зорову систему, але й крізь позанервові рецептори (специфічні енергочутливі протеїни, що детектують критичні зміни рівня енергії у клітинах та виконують функції "сенсорних" систем клітин) та крізь точки акупунктури. Тим самим підтверджується важлива роль електромагнітних хвиль оптичного діапазону в забезпеченні нормальної життєдіяльності живих організмів. Сучасний підхід до БІОПТРОН-ПАЙЛЕР-світлотерапії (поляризованим поліхроматичним некогерентним низькоенергетичним світлом) полягає в комбінованому (місцевому і системному) впливі електромагнітними хвилями біологічно необхідного діапазону.

Ключові слова: точка акупунктури, світлопунктура, поляризовані електромагнітні хвилі, периферійні нервові рецептори, біль, Пайлер, HSP-білки, PAS-білки, БІОПТРОН, фоторецептори.

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МЕХАНИЗМЫ ПЕРВИЧНОЙ РЕЦЕПЦИИ ЭЛЕКТРОМАГНИТНЫХ ВОЛН ОПТИЧЕСКОГО ДИАПАЗОНА КАК БИОФИЗИЧЕСКАЯ ОСНОВА ТЕРАПИИ ПОЛЯРИЗОВАННЫМ СВЕТОМ

С. А. Гуляр

Международный медицинский центр инноваций ZEPTER

Обосновано существование отдельной функциональной системы регуляции электромагнитного баланса организма и сформулирована рабочая концепция светотерапии. В основу положена возможность использования точек акупунктуры для ввода биологически необходимых электромагнитных волн в систему их проводников в организме, которая может рассматриваться как средство транспорта энергии поляризованных электромагнитных волн оптического диапазона. Зонами-реципиентами названы органы, испытывающие электромагнитный дисбаланс в связи с избытком биологически неадекватных излучений и являющиеся мишенью для перекисного окисления, в первую очередь нейрогормональная и иммунная регуляторные системы организма. Электромагнитная стимуляция или модификация функций зон-реципиентов определяет получение лечебного и полезного эффекта, комбинация которых с местными репаративными процессами позволяет достичь клинической цели. Приведены собственные и литературные экспериментальные данные о развитии физиологических реакций (анапгезия) в ответ на действие БИОПТРОН-светом наточки акупунктуры. Приведены экспериментальные факты, подтверждающие предположение о том, что живой организм способен воспринимать действие электромагнитных полей оптического диапазона не только через зрительную систему, но и через вненервные рецепторы (специфические энергочувствительные протеины, детектирующие критические изменения уровня энергии в клетках и выполняющие функции "сенсорных" систем клеток) и через точки акупунктуры. Тем самым подтверждается важнейшая роль электромагнитных волн оптического диапазона в обеспечении нормальной жизнедеятельности живых организмов. Современный подход к БИОПТРОН-ПАЙЛЕР-светотерапии (поляризованным полихроматическим некогерентным низкоэнергетическим светом) заключается в комбинированном (местном и системном) воздействии электромагнитными волнами биологически необходимого диапазона.

Ключевые слова: точка акупунктуры, светопунктура, поляризованные электромагнитные волны, периферические нервные рецепторы, боль, ПАЙЛЕР, HSP-белки, PAS-белки, БИОПТРОН, фоторецепторы.

Introduction. Life development on Earth for millions years has passed under influence of the electromagnetic fields having natural fluctuations depending on cosmic and Sun activity, Earth and Moons rotation. Living organisms created the physiological mechanisms to adaptation to such important environmental factor. A physiological expediency for existence of the mechanisms for the electromagnetic energy utilization to cover the metabolic needs of living organisms has been proved now. The electromagnetic background was shown to be not indifferent for the functional systems, and its fluctuations within the range exceeding the natural fluctuations inevitably reflect on their state. Consequently, the pathogenesis of many premorbid states, immunodeficiency and diseases can include an electromagnetic destabilization of the functional systems. Fluctuations of the electromagnetic background, for example in changes in meteorological conditions, disturb the nervous impulsation from the skin receptor zones, and thereby cause different deviations of the vegetative functions.

The work aims to describe the functional system of electromagnetic regulation in a body, to show the data of a role of its separate links, and to elicit the mechanisms and significance of the polarized light of BIOPTRON (PILER) for electromagnetic disbalance compensation.

Methods are described when reporting the concrete experiments.

Results. Functional system of electromagnetic balance regulation. It is expediently to trace a way of the electromagnetic signals in a body from the position of necessity of the external electromagnetic provision for normal functioning of the fundamental biophysical processes. It is evolutionally logical to form the receptor, conductive, utilizing and regulating structures. Recently, a hypothesis has been formulated [28] that the acupuncture points (identified in all mammals including human) might be considered as receptors for perceiving the electromagnetic waves and transmitting them into different organs and tissues. Aproperty ofthe acupuncture points to perceive the mechanical or thermal action is well known, and therefore effectiveness of the acupuncture therapy is unchallenged now. Ability of the acupuncture point to react on exposure with BIOPTRON-polarized light we proved experimentally in 1999 [30]. Fig. 1 shows different reactions to acute pain in animals after diffuse and target application (on the point E-3 6) of BIOPTRON-polarized light. It is shown that 10-min light

exposition on the point E-36 leads to a noticeable analgesic effect, i.e. to development of response to non-

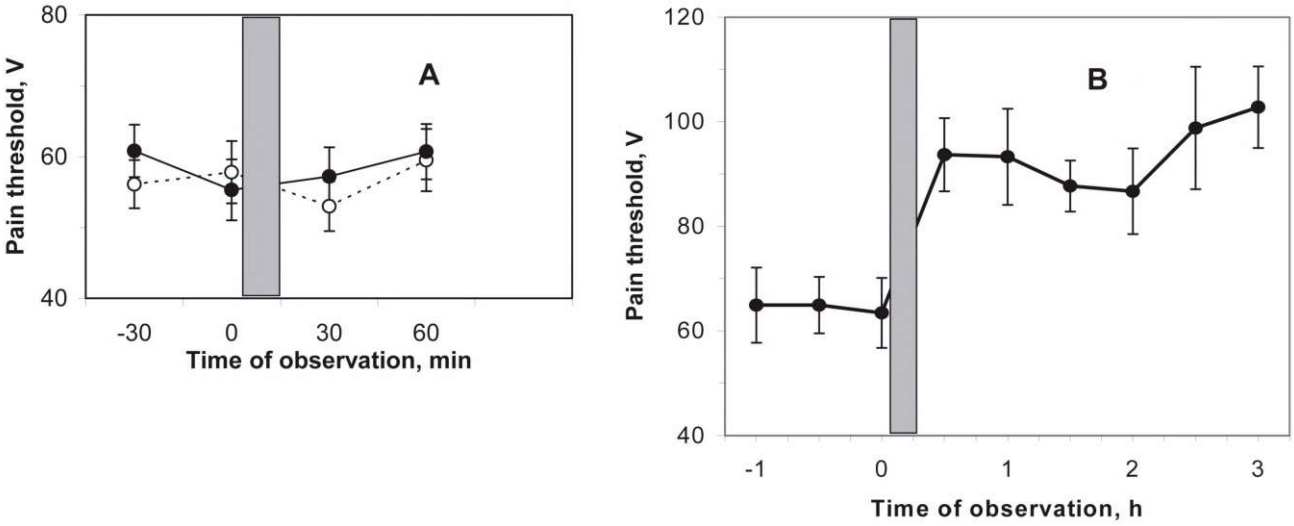

Fig. 1. Effect of PILER-light on development of pain behavioral response depending on application zone (acute pain): A - effect on the animal totally, B - on the acupoint E-36. Vertical scale - pain threshold (vocalization) in volts, horizontal scale - observation period. Shaded area - light application.

Following studies confirmed a possibility of penetration of the electromagnetic waves of visible, infrared and microwave ranges from acupuncture points to different levels of the central nervous system, and established, that the effect in pain syndrome achieves the level of the brain endogenous opiate systems [17, 27,18,19].

The acupuncture points as electromagnetic receptors have some features compared to surrounding tissues. They can perceive the electromagnetic waves of different frequency (laser, microwave, extremely high-frequency, technogenous radiation, although the natural stimulator is the Sun range) causing hereafter the resonant responses of atoms and molecules in the structures having the functional links with these points [28].

Recently the data of semiconductor properties of collagen, integration of water molecules into the cluster structures have yielded, which determine the liquid crystalline properties of the connective tissue. They explain a disagreement between functional effectiveness and anatomic indefiniteness of the east medicine concept «meridians» or «canals» [24] .According to this approach, the system of acupuncture points, meridians, as well as constant and alternating electromagnetic fields of human and animal body belongs to the integral system of liquid crystalline fibers of the collagen, which is a base of the connective tissue. From this position, meridians can be considered as oriented in space collagen fibers surrounded with layers of bound water and providing the permanent conductive ways for fast interconnection of all body structures to allow its functioning as an integral system. Such a liquid crystalline «net» participates in rapid responses to fluctuations of the external electromagnetic waves, in reacting to microquantity of substances, in forming the increased reactivity to allergens, in urgent reactions to damage, and in fact provides a body integrity through coupling the somatic, visceral and nervous structures.

The opinion, that Chinese meridians are the part of electronic «magnetic skeleton» of the organism, made up by summary electromagnetic field of its sells is spreading widely now. According to the hypothesis [42] meridians reflect trajectories of running electromagnetic waves in organism, evoked by coherent micro waves EMF connected with cells membranes. Direct measurement within frequency range 53-78 GHz with 5 10^{-23} Wt/Hzcm^2 registered non-equilibrated x-ray component of human body within mm-range.

All aforesaid evidences a reliable existence of dependence of complicated living beings, including human, on the external electromagnetic background created by Earth and Space. The electromagnetic waves via changing features of the body electromagnetic frame cause the corresponding resonances and fluctuations of the electric potentials in its molecular structures, participate in management its functions and provide

maintenance of electromagnetic homeostasis (equilibrium). If physical characteristics of waves (intensity, form, frequency, length and etc.) exceed the limit physiological parameters of the endogenous electromagnetic fields, it will lead to disorders of coordination in the nervous, hormonal and immune systems.

Therefore, it is logically to assume existence of the separat ***efunctional system ofelectromagnetic balance regulation,*** containing all components of the classic functional system according to P. K. Anokhin [1]. In contrast to characteristic of any anatomic sign of the participating component, the system approach allows to accent the principles of organization of many components from many anatomic systems and to obtain certainly a result of activity of this branched system. As far as in 1990, Limansky Yu. P. proposed a hypothesis of possible existence of the system of «ecoceptive sensitivity» [28], which could control the changes of the factors of external medium (electric, magnetic fields etc.).

Based on above-mentioned facts [20, 22], a structure of the functional system of electromagnetic regulation is shown in fig. 2. From our point of view, performance of this system depends on the properties of external electromagnetic flux (biologically adequate wave ranges, polarization) and presence of the evolutionally formed mechanisms for utilization).

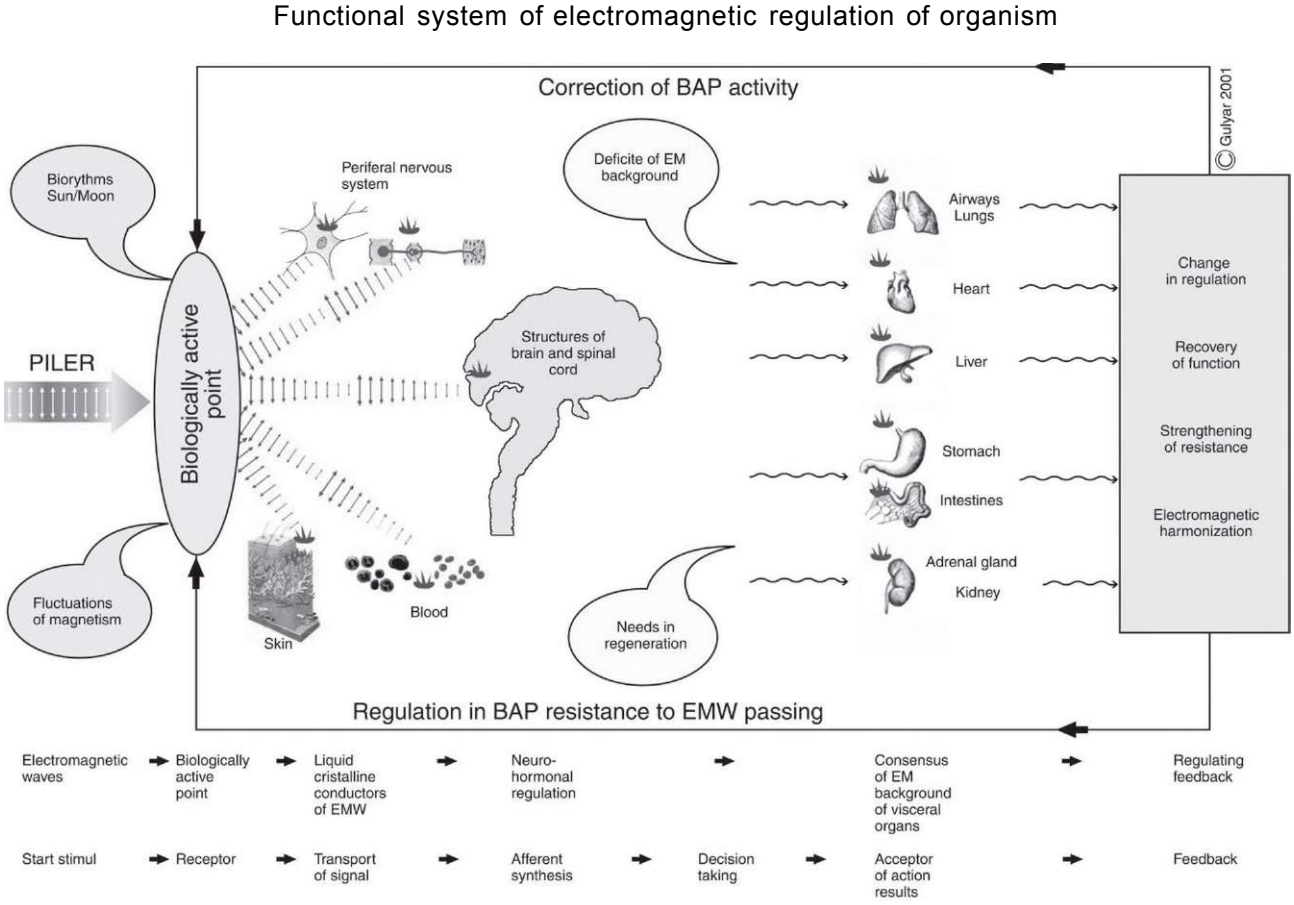

Fig. 2. General scheme of functional system of electromagnetic balance regulation of organism.

The polarized electromagnetic waves (start stimulus) cause activation of their receptor (an acupuncture point) (fig. 2). The electromagnetic signals are translated on the ways with the best their conductivity (connective tissue stroma). Nervous structures and electromagneto-dependent processes stimulated with electromagnetic signals facilitate «decision-making» and determine the acceptor of action result (visceral organ). As recipients, one can be considered the organs having electromagnetic disbalance due to excess of biologically inadequate radiation, suffering from overload by free radicals (peroxide oxidation). Foremost, these are neurohormonal

and immune regulatory systems of a body. Their functional state after electromagnetic exposure determines a content of feed-back. Such a self-regulation (coordination of acquired and due energy background of the organ) spreads on the absorbed energy amount regulated with activity of electromagnetic reception.

Main mechanisms and conception of piler light therapy. The presented data show that the method of PILER light therapy is the most suitable for providing the most physiological way to recover the electromagnetic harmony on all levels - from molecular to systemic. Energetic replenishment of the electronic orbit components and transfer of electrons onto the higher levels, that facilitates increasing in atomic chemical activity, occurs during direct action of the electromagnetic waves of visible and infrared start part of the spectrum on the biological substrate. Redistribution of the intermolecular energy leads to molecule modification that determines a big stabilization of their structures. Recovery of structure of the cellular membrane areas owing to electromagnetic reconfiguration of the molecules results in increasing in membrane potential and ability to sustain an action of free radicals. PTLER-light is particularly effective in cases of electromagnetic disbalance that determines a following aligning therapeutic effect. This is a manifestation of biophysical aspect of antioxidant effect of PILER light. The manifestations of general mechanism of PILER-light action are apparently different and depend on the regional properties of perceiving area on the skin surface. The above-described process exists in all cases of direct (local) exposure. However, if the biologically active (acupuncture) point is within zone of light application, there will trigger a mechanism of «facilitated» input of the electromagnetic energy of biologically necessary range and following its transport to consumers situated in the electromagnetic «frame». So, there is a possibility of systemic influence on the organs situated far from the application area. This mechanism is a base of analgesic and correcting visceral systems technologies [19, 29].

Because of polarization, PILER-light possesses abetter penetration compared to unpolarized electromagnetic waves. This opens one more chain of useful mechanisms connected with direct effect on formed elements of blood, which passes through the skin capillaries. Recovery of their performance strengthens a structure of red cell membranes and prolongs a period of active live of red cells in blood flow, on the one hand, and activates leukocyte and lymphocyte functions for production of immunocompetent proteins, activation of phagocytosis etc, on the other hand [36,41]. It is typically that almost every light application involves automatically the capillary net in the alight zone and accordingly triggers the immunostimulating mechanism that is overwhelmingly important for practical medicine.

The current conception of PILER light therapy consists in combined application of local and systemic exposure of the polarized electromagnetic waves within biologically necessary ranges with use ofthe specialized (biologically active) input gates, liquid crystalline conductors and whole connective tissue frame to transfer the electromagnetic energy into the regulatory systems or zones with its deficit or disbalance.

We have obtained the experimental data supporting directly all above-mentioned. The treatment with BIOPTRON-light (12 sessions) has been carried out for children and teenagers after chronic radiation exposure (Chernovyl accident). The first group (12 patients) received the light applications for 10 minutes (BIOPTRON-2) on the sacrum and sternum areas (biologically active zones). The second group (14 patients) received the applications according to the above-mentioned scheme on the zones considered to be biologically inactive (skin areas in the anterior-lateral surface of both femurs).

The results showed that application of BIOPTRON-light caused in the patients of both groups the positive changes in functions of external respiration, immunity, as well as inhibition of peroxide oxidation (fig. 3-4). Moreover, the patients with BIOPTRON-light applications on the biologically active zones had significant improvement of lung ventilation function. In such patients, bronchospasm was corrected or improved on different levels of the bronchial tree. After the light therapy course, the index of specific respiratory liberation ofwater increased by 22.5 % ($P<0.05$)inthe first group, whereas in the second group, there was only a tendency to growth (7.7 %). An analysis of the peripheral blood parameters showed mean increase in leukocyte count by 22.6 % ($P<0.05$) in the first group and 17.9 % ($P<0.05$) in the second group. The absolute number of lymphocytes increased respectively by 20.9 % ($P<0.01$) and 8.2 % (tendency). The cellular immunity parameters improved in both groups - the absolute number of T-lymphocytes increased by 28.0 % ($P<0.02$) and 30.4 % ($P<0.05$); B-lymphocytes - by 36.4 % ($P<0.01$) and by 19.0 % (tendency). An analysis of changes in humoral immunity evidenced significant rise of serum IgG content by 44.4 % (PO.Ol) in the first group and by 25.7 % ($P<0.02$) in the second group. Both groups had a tendency to increasing in IgA and IgM. After the light therapy course, there has been noted a lowering in intensity of free radical

oxidation processes in the biomedia, that was evidenced by changes in the integral index of initiated chemiluminescence in biomedia - light sum. Mean light sum in the serum decreased by 74.1 % (P<0.05) in the first group and by 21.6 % (P<0.05) in the second group; in red cells-by30.4 % (P<0.05) in the first group without significant change in the second group; condensate of the expired air had a tendency to lowering in both groups. Thus, BIOPTRON light therapy via the biologically active zones has better clinical effectiveness compared to simple applications on the skin that is proved statistically.

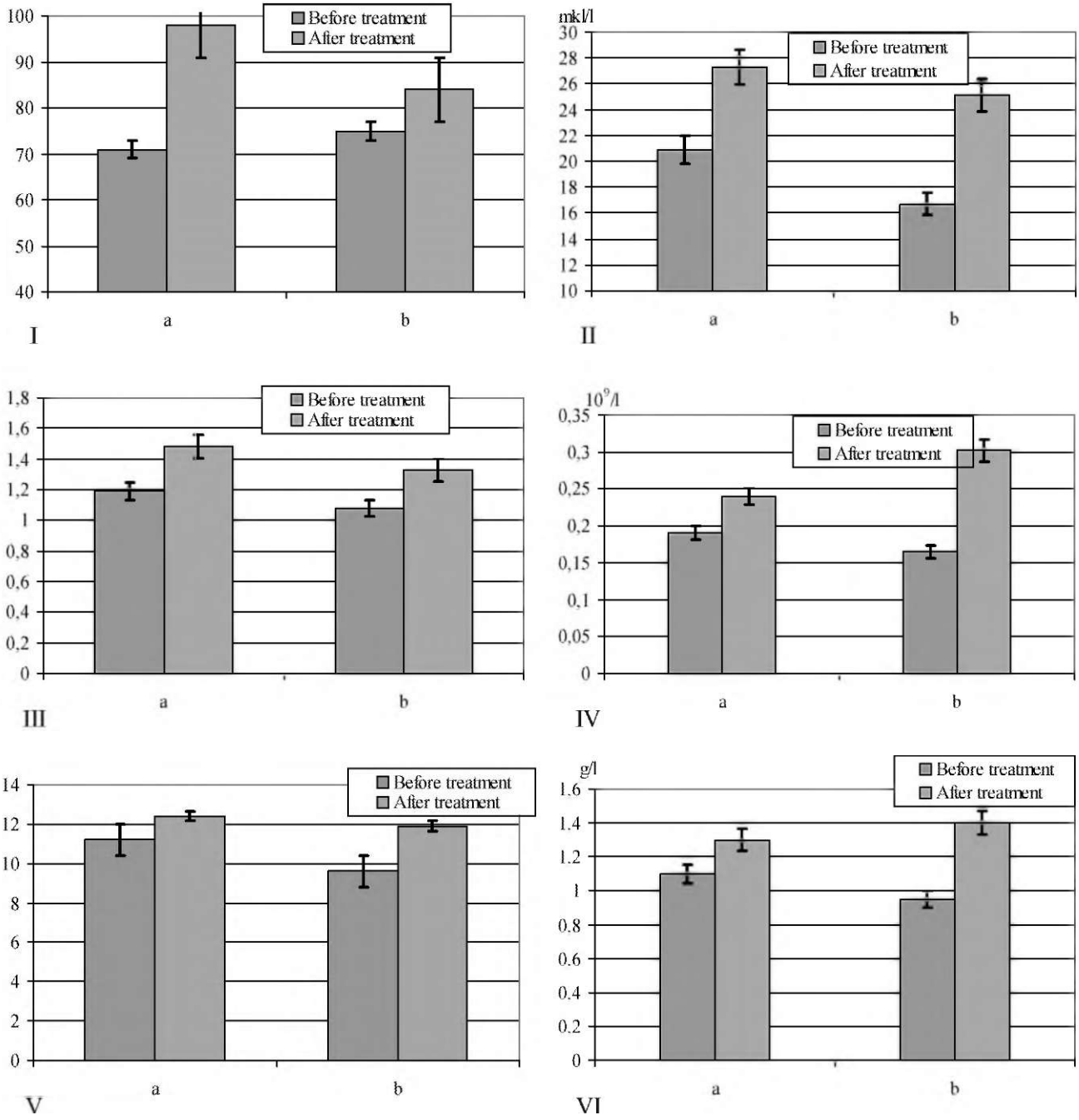

Fig. 3. Changes in respiratory and immunity variables before and after treatment course of BIOPTRON light therapy in acute (a) and chronic (b) radiation exposure: I - maximal expiratory flow rate (MEF) in bronchi small (a) and medium (b) diameter; П - bronchial water generation; in - T-lymphocytes; IV - B-lymphocytes; V - immunoglobulin G; VI - immunoglobulin A.

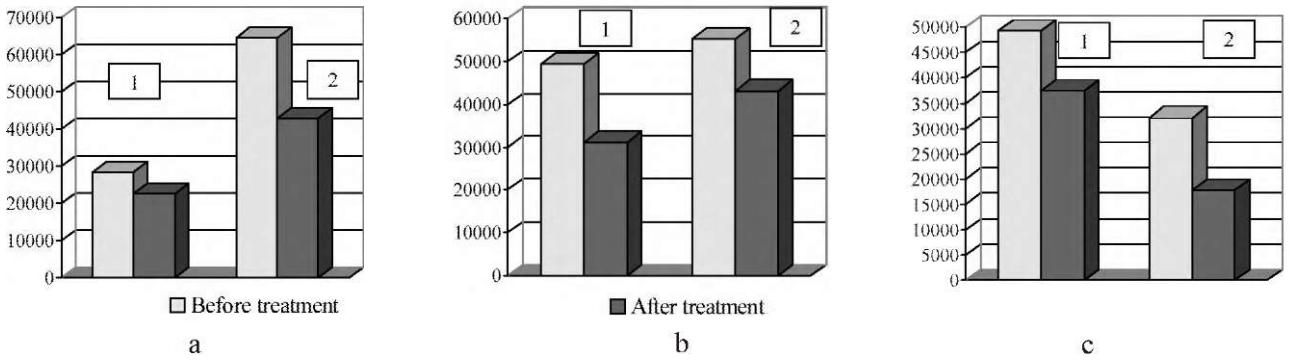

Fig. 4. Changes in peroxide oxidation before and after treatment course of BIOPTRON light therapy in acute (1) and chronic (2) radiation exposure: a - light sum of chemiluminescence in blood serum; b - erythrocytes; c - exhaled breath condensate (c).

To understand general principles of the PILER light effect, knowledge of mechanisms of primary reception of the electromagnetic waves within optical range is of particular importance. It requires study of interrelations between the body cellular or molecular structures and the electromagnetic waves and fields of exogenic and endogenic origin.

Polarized light and living organisms. Each species is adapted to some areas of the optical or light spectrum range (λ=290-700 nm). Human and some other species can distinguish the wavelengths of optical range (color sight), as well as their intensity. The highly sensitive visual system has been developed during evolution to percept the electromagnetic waves within the optical range. However, besides this system, some species for communication and orientation in space use effectively ultraviolet (visual system of insects), infrared (fossa receptors in snakes, some butterflies) ranges, low-frequency electromagnetic waves (electroreceptors in fishes and amphibia), as well as frequencies of geomagnetic field (birds, fishes).

Transformation of the natural light into the polarized one is associated with optical anisotropy of the substance, i. e. with distinction of optical properties in different directions. When entering a body, the polarized electromagnetic waves get to the medium with different anisotropic properties. This leads to spatial redistribution of light intensity due to differences in electromagnetic and, in particular, optical properties of distinct structures of living tissue. In natural environment of living organisms, there is a plenty of differently directed polarized light, which arises owing to dispersion of sunlight within atmosphere and hydrosphere and its reflection by water and other surfaces (soil, rocks, vegetation). Animals use the polarized light to form behavior of different types. It carries information providing via the visual system orientation in space, better contrast, food search. The human eye is also sensitive to the polarized light as evidenced by data about sensitivity of the eye retina receptors. As a response to stimulation of the eye retina with polarized light, the evoked potentials arise in the human brain visual cortex [6, 8, 12, 13].

Moreover, the extraocular way of polarized light action on organism exists. It implicates reception of the polarized light through the biologically active points or acupuncture points, that has been also confirmed experimentally [21, 30].

In a body, there are also the internal optical processes stipulated by its stereoisometry. Distinctions in disposition of atoms in space (with identical sequence of atom bonds in the molecule) determine existence of the optical isomers. These molecule pairs possess the optical activity and rotate the plane of polarized light by the same angle, but in the opposite sides: D- or (+)-isomer is right-handed, L- or (-)-isomer is left-handed.

Molecules of proteins, sugars and lipids, as well as biologically active substances such as enzymes, hormones, vitamins and mediators have asymmetric structure, and living organisms use only one definite isomer. Molecules of protein consist of L-amino acids, and all animal sugars have only D-molecules. Mirror isomers of hormones, vitamins, enzymes lose their activity and become useless for a body.

Chirality (from Greek «cheir» - a hand) is a property of the molecule not to overlap its reflection in an ideal flat mirror and a necessary condition for optical activity of the molecule. Chiral molecules comprising a living organism have symmetry of quite definite kind. For example, amino acid molecules can be only left-handed, and sugar molecules - only right-handed. Living organisms contain a lot of chiral components, but proteins

consist of only L-amino acids, nucleic acids - only D-nucleotides.

Very important is the fact that chiral molecules polarize light, and therefore all nonpolarized light absorbed in a body turns into the polarized one. This allows us to consider the physiological effects of the electromagnetic waves within optical range as a result of the polarized light action on a body. The difference between action of polarized and nonpolarized light on a body can eventually be only quantitative, because transformation of nonpolarized light into polarized is accompanied with loss of energy. Additional delivery of the polarized light from outside (PILER light) facilitates significantly a natural way of the intracellular polarization.

In living organism formed by complexes of large particles, for example, by protein molecules, light or electric fields causes a glowing (fluorescence), i.e. radiation of plane-polarized light, with a polarization degree depending on the molecular mass of radiating molecules, their dimensions and form, as well as on the medium parameters (viscosity, pH etc). Photons emitted by electrons of the excited molecules form the secondary flux of the electromagnetic fields dispersing in different sides and exciting other molecules. Because of diversity of the molecules in a body, this secondary radiation is wide-band and incoherent. Penetration of the electromagnetic flux into the living tissue is likely facilitated by transfer of the excited molecules with blood and lymph in a body as well as by diffusion in the connective tissue within the frameworks of above-described functional system of electromagnetic regulation.

Living organisms - liquid crystalline systems. This approach to the organism is based on original statement that living organisms are liquid crystalline systems, i.e. their cells as well as the extracellular area - matrix or connective tissue - contains the liquid crystals [24]. Existence of the liquid crystalline structures in a body became evident after discovering the optical detectors allowing to see living organisms in color interference caused by liquid crystalline structures of their organs. Work of these optical devices is based on the phenomenon of light flux polarization.

Crystals is known to be solid substances with high orderliness of atoms or molecules forming the periodically repeating internal structure. Crystals can transmit only the light component with vector of electromagnetic induction E lying on the plane parallel to the crystal optical plane. For remaining light flux, the crystal will be opaque. Thus, a crystal «screens» (polarizes) light. Apossibility to manage polarization has appeared after studying the liquid substances with long molecules, which are sensitive to the electrostatic and electromagnetic field and can polarize light. These amorphous substances due to likeness of their electrooptical properties to those of the crystal substances have been called as liquid crystals.

The liquid crystal is a specific aggregate state, which allows substance to manifest properties of both crystal and liquid. The liquid crystals consist of the molecules ordered in space and forming crystals (a property of crystals), but they have not the hard crystal latitude. Presence of the «order» in spatial orientation of molecules is a compulsory property of liquid crystals, which approaches them to the ordinary crystals. It can be manifested, for example, by similar orientation of all long axes of the molecules in a liquid crystal. These molecules must have a prolonged form. Other properties of liquid crystals include significant dependence of their physical characteristics on temperature and very high sensitivity to external magnetic and electric fields.

Liquid crystals possess double-refractivity, i.e. ability to refract light in different degree depending on polarization. Some kinds of liquid crystals have unusually high optical activity - ability to rotate the polarization plane of the transmitted light. It means that the linearly polarized light spreading in the medium of liquid crystals changes orientation of the polarization plane. The rotational ability value for liquid crystals is hundreds and thousands times above the value for the most optically active crystals, and liquid crystals have unusually dependence on light wavelength. For example, the value of polarization plane rotation can be positive for short wavelengths and negative for light with longer wavelengths. These properties are considered to be ideal to ensure fast intercommunication in living organisms, necessary for their functioning as an organic whole [24].

Accordingly, there is a necessity in further scientific consideration of the statement that the system of the acupuncture points and constant electromagnetic field of living organism are created by the integral system of liquid crystalline collagen fibers, which compose a big part of the connective tissue. The collagen fibers surrounded with water layers provide the proton conductive ways for rapid intercommunication of all parts of the body, and thereby allow its functioning as the integral coherent system. This liquid crystalline continuum provides organism with link of somatic and nervous structures during interrelations with external medium having the considerable electromagnetic component [24].

Cellular-molecular mechanisms for perception of electromagnetic waves. Light flux determines appearing of five kinds of its interaction with living tissue: reflection; refraction; through path; absorption and dispersion. Biological effect of light is mainly stipulated by its absorption. This effect depends on interaction of the external photons with molecule electrons in a body. When a photon gets an electron, the photon energy is absorbed by the electron, which increases its energy through passing on the higher orbit. Then the electron via the intermediate orbits returns on the initial orbit and emits the photons with different energy (radiation wavelength) to be equal to differences of electron energies on the intermediate orbits. Energy absorption strength is substantially dependent on the tissue structure. Skin absorbs 25-30 %, muscles and bones - 30-80 %, and parenchymatous organs - up to 100 % of infrared radiation within the range 800-1200 nm.

The protein-mediated transfer of the electrons is a key process of living nature. It helps perform the various biochemical transformations - from photosynthesis to aerobic respiration. Many proteins participating in this transfer have the complicated structure and contain redox-active coenzymes. Electron transfer is carried out by different systems, such as flavocytochromes, NO-synthase, nitrogenase and cytochrome complexes. It has been hypothesized that the energy transfer in the cells is performed by means of different structures of the cytoskeleton [47].

The molecules sensitive to weak electromagnetic fields within different ranges include electro-, photo-, and other kinds of receptors, structural molecules, G-proteins, enzymes (for example, cAMP-dependent protein kinase, protein kinase C, lysozyme, Na+/K+ATPase), chromosomes, protein and lipid biopolymers. Most protein molecules can reversibly change their conformation state owing to different combinations of hydrogen bonds, disulfide bridges and hydrophobic forces. The conformation conversions are performed through nonlinear changes or intermittently with overcoming the energy barriers between these states. Accordingly, proteins are the dynamic structures generating the fluctuations. The protein components continuously vibrate within the time range from femtoseconds (1(^{5} s) to a few min. The most considerable fluctuations in the biological systems occur within nanoseconds (10^{9} s) [23]. It is important to emphasize the fact that many proteins (as well as other chemical compounds such as lipids) are assembled into the multidimensional groups. The collective interactions are frequent in such structures, and generated in this case fluctuations spread owing to coherence and have the definite information significance [2,10,16].

The extraocular way causes excitation of the intracellular energocarriers, which is accompanied by absorption of the light energy, displacement of electrons within the chains of the oxidation-reduction reactions and trigger of the mechanisms for adaptation of organism to changes in the external medium.

In the respiratory chain system of animal cells, it has been found that enzymes absorb energy of near infrared range (700-1000 nm) [39]. It has been shown that between proteins or proteins and DNA under influence of frequencies of the infrared and optical ranges, there is an interaction through energy absorption and electron derealization [9].

Cellular sensors of electromagnetic fields. It has been established that all living systems - from protozoa to human - have specific energy-sensitive proteins [44]. These sensory proteins immediately detect changes in energy levels in the cells, which living organisms appraise as stress-factors, and turn into signals causing a number of intracellular processes and behavioral responses directed to recovery of optimal energy level in the structures.

The sensory proteins sensitive to changes in energy level in cells were originally found in bacteria. It has been established that protein charges in cells, and their membranes create very strong electric fields, which act on the adjacent proteins. Therefore, activity of many proteins can affect the membrane electric field, and each cell protein can change functions of other protein through the local electric field without any contact between proteins. Coupling of different proteins such as enzyme and substrate, antigen and antibody on the membrane can result in more specific electrostatic interactions [4].

The specialized proteins are the cellular electromagnetic sensors, and «reflex» responses are realized via the mechanism of gene activation and expression intensification (a process of converting coded gene information into the compounds used by cell) of correspondent «protective» proteins. Participation of the nervous system is not necessary for such «protective reflex» responses; this process occurs on the cellular level, i.e. in the areas with primary disturbance of homeostasis.

The specialized proteins control frequencies and amplitudes of the electromagnetic waves. These parameters reflect intensity of metabolism in mitochondria. Their activation triggers the genetic programs in cells, allowing to stabilize functions in a body. The electromagnetic sensitivity of cells depends

on their functional state: it is higher in the tissues with definite pathological changes than in healthy tissues [3 5].

Among the «sensors» of cells, the most studied are proteins of thermal shock (HSP-proteins) andproteases-activators of plasminogen (PAS-proteins). There is information of animal phytochromes, extraocular photoreceptors and magnetosensitive compounds, which are sensors, too.

The distant communication between some cells or between some organisms can be accompanied with transmission and reception of electromagnetic signals via the membrane receptors and enzymes [46]. This hypothesis of «electroconformation interaction» is based on the experiments showed that membrane ATPases can absorb energy of the electromagnetic fields with definite frequencies and amplitudes and use it for chemical work. This hypothesis explains the mechanisms for modulation of activity in membrane proteins under influence of the electromagnetic field, and the mechanisms of the reaction, which produces an electric signal accompanied with energy dissipation.

A hypothesis has been proposed that the functioning nervous system in mammals generates and uses for its intercommunications the electromagnetic fields of the microwave range [43]. Estimation of the potential energy of the proteins built-in into the neuron membrane and its comparison with the potential energy of the extracellular positive ions allowed to conclude that the integral proteins are emitters and absorbers of microwaves. Mathematical analysis of emission and resonance properties of human skin integument showed that they might work with microwaves within a range 200 MHz to 3 GHz [43].

Distributing in the organism, the electromagnetic waves manage the intracellular processes and interconnect them. The cellular membranes, protein molecules, metabolic mechanisms participate in generation of the electromagnetic fields. Resonance in membranes determines the frequency of generated oscillations. The cytoskeleton proteins in cytoplasm oscillate at the same resonant frequencies and transfer energy on the membranes. It has been proved that cells create the electromagnetic impulses, which transfer signals and manage the functions in a body. They have electric charges, and their surrounding fields consolidate with forming a single electromagnetic field distributed around organism. External natural and artificial electromagnetic fields, as well as diseases, changing normal electromagnetic characteristics of biological molecules and cells, cause disbalance in single field of a body and serious disorders in functioning of its systems.

HSP-proteins. The intracellular proteins called chaperons form a part of early cellular response to the thermal stress. They include peptides of thermal shock (HSP) such as groEL, HSP-60, HSP-90. HSP-proteins are synthesized just after external stress action. They help to maintain homeostasis in cells, removing denaturated or malformed proteins and providing stable work of the cells. Hsp-proteins protect cells from toxic action of oxidative stress caused by tissue damage, and foremost mitochondria from denaturation [38,40]. Hyperthermia, ischemia, oxidative stress, inflammatory states, deficit of glucose, impairments of calcium homeostasis and pH deviations are the signals for production of HSP-proteins and lead to their intensive accumulation. Excess ofHSP-proteins hastens recovery of affected tissue, organ or system, restoration of their normal structures and functions. The general mechanism of interaction between electromagnetic waves and cells is considered to be the processes causing response of organism to stress under influence of different electromagnetic waves [32].

PAS-proteins. PAS-proteins (proteases-activators of plasminogen) have been found in human epidermis, where they are produced by keratinocytes, immune cells and fibroblasts. They maintain the epithelium homeostasis and participate in skin regeneration process. It has been shown that PAS-proteins play an active role in movement of growth cones of brain cell axons during development of the nervous system and in regeneration of the nervous fibers.

It has been established that PAS-proteins play a fundamental role in maintenance of homeostasis on the intracellular level. PAS-proteins in the cells are the sensors of the electromagnetic waves within optical range, sensors of oxygen tension, level of oxidation-reduction potentials and some other stimuli. PAS-proteins react on these metabolic signals by changing in the system of electron transport [45].

It is known that hypoxia causes a cascade of physiological reactions such as glycolysis, angiogenesis, vascular cell proliferation and modulation of adrenergic transmission of signals. It has been proved that the hypoxia-activated genes have close relations with adaptive processes in the organism and survival of normal tissues. In hypoxic conditions, the genes expressing PAS proteins became activated in DNA. PAS-proteins included into the composition of the potential-managed ionic canals, owing to their sensitivity to action of electromagnetic fields and hypoxia, are considered to be the structures, which serve as a «system of early notification» about any lowering in energy level in the cell.

Phytochromes. Plants perceive light via a few types of photoreceptors including phytochromes. In animals, blood bilirubin is considered to be the photoreceptor compound able to convert the external signals of electromagnetic fields of optical range into the start signal for switching on the biological clock and thus to mediate the antidepressant effect of the light [37]. Activation or inactivation has been proved for different enzymes, for example, the direct reactions of enzymes to light, which manifest in substrate production, inhibitor dissociation, in chemical reactions of amino acids, luminescence of chromophores or enzyme substrates. Indirect effects of photomodulation of enzymes realize through expression of genes, phytochromes, synthesis of proteins and membranes [25].

Extraocular photoreceptors. The proteins (cryptochromes) belonging to the family of plant receptors of blue light (Cryl, Cry2) has been found in mammals. They are considered as light receptor candidates for managing the biological clock. Ahomolog of opsin family of retina and epiphysis - encephalopsin has been identified in the mammalian brain [3]. The most concentrations of encephalopsin have been found in the hypothalamus nuclei connected with photoreception of extraocular brain structures in vertebrates not belonging to the mammals class. Encephalopsin has been also revealed in other areas of brain and spinal cord of mammals. Encephalopsin considered as the first supposed extraocular opsin in mammals could play a role in direct photoreception of brain [3].

The photoreceptors, which do not belong to cones and rods, but participate in managing the biological clock, have been found in mouse retina [15]. Moreover, birds have the brain extraocular photoreceptors, which are the component of the circadian system and are situated in the suprachiasmatic nucleus and epiphysis [7]. Vertebrates not belonging to mammals possess multiple extraocular photoreceptors having phytopigments other then those in the eye cones and rods [14].

The epiphysis in mammals contains the photoreceptor specific proteins. The photoreceptors similar to those in eye retina have been found in the epiphysis of some coldblooded animals [34]. It has been supposed, that the epiphysis in such animal is not only a simple light detector (photometer), but can process the electromagnetic light fluxes and distinguish them from light signals, which do not participate in the photoperiodical functions.

Acupuncture points - electromagnetoreceptors. The acupuncture points are usually considered as skin specific zones possessing the particular receptor properties. They can cause therapeutic effect under influence of different stimuli: mechanical (pressure, vibration, vacuum), thermal (heat, cold), electromagnetic (light, electric and magnetic fields). Such apolymodality of the acupuncture points as independent receptor organs approaches them to the electroreceptors, which are known [5] to possess high sensitivity to electric and magnetic fields and be activated by mechanical and thermal stimuli. This affords ground for assumption that the acupuncture points are electromagnetoreceptors, sensory endings, for which changes in the electromagnetic field strength can be adequate stimuli.

The acupuncture points have round or oval form and diameter 3 to 12 mm. High concentrations of neurotransmitters, neuromodulators and hormones have been found within the majority of acupuncture points and along the meridians, with each meridian having only own compounds. Intensive metabolic processes accompanying with increased oxygen consumption, raising of temperature (0,6 °C on the average) and infrared radiation occur in all acupuncture points. Fluctuations of the electromagnetic fields approximate to the spectrum of visible light, with intensity of such fields depending on body activity level, have been found in the acupuncture points situated along the meridians. Some electric parameters of the acupuncture points lying on the meridians support the experimental data that a human body can generate and perceive microwaves.

The acupuncture points have low electric resistance (3-300 kOhm) compared to surrounding skin (150-1500 kOhm). A parallel between changes in electric resistance and painfulness of the corresponding acupuncture points has been noted in pathological processes in the visceral organs. Increase in sensitivity of the acupuncture points has been found in pain. The daily rhythmic oscillations of electric potentials with cycles 3-6 s and intervals 15-30 s between groups of 5-7 cycles as well as changes in electric conductivity have been registered in a number of acupuncture points.

We have hypothesized that the acupuncture points are electromagnetoreceptors, and the coupling them meridians are the ways of their energy transmission in the homeostasis system supporting stable electromagnetic parameters in an organism [28]. It has been recently proved that the acupuncture points are sensitive to energy of any natural physical process. This is evidenced by therapeutic effects resulted from action on the acupuncture points of pressure, vibration, local vacuum areas, electromagnetic energy (cold, heat, light, magnetic, electric fields), as well as reactions of the body functional systems.

Tracing the ways of the perception propagation arising in stimulation of the acupuncture points has allowed to create the human body maps with the perception distribution lines called meridians. It has been experimentally shown that human skin areas on the meridian lines have zones filled by wide bundles of collagen and reticuline fibers. These fibers are oriented in different directions and possess the properties of liquid crystals, piezoelectrics and semiconductors, i.e. can transform different kinds of body energy into the electric energy.

There is one more hypothesis that muscular-tendinous tissue plays a leading role in forming meridians in a body and transmitting along them energy as ions, electrons and protons. Besides consolidating organs and systems into the single body, the connective tissue can generate and transmit energy and consequently work as a communication net for distribution of the electric energy flows between different parts and within each part of a body.

In conclusion, the experimental data confirm ability of living organism to perceive action of electromagnetic waves of optical range by three ways: through the specialized sensitive ways of nervous system, through the extranervous receptors («sensory» systems in cells) and through the acupuncture points.

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