STUDY OF THE INFLUENCE OF DIAGNOSTIC ULTRASOUND ON THE HUMAN AQUA-SYSTEM WITH BIO-WELL DEVICE

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Abstract

Objective: To evaluate the influence of diagnostic ultrasound onto the condition of people using different several technologies.

Materials and Methods: The methods of heart rate variability (HRV), Electrophotonic Imaging (or gas discharge visualization EPI/GDV), and Akabane acupuncture test were used to assess subjects. Analysis of data from 138 apparently healthy people aged between from 14 and to 63 years, was carried out.

Results: In the Akabane test, after exposure to diagnostic ultrasound, imbalance in some channels was observed in all subjects. Analysis of the HRV data showed a shift of indexes to the pronounced sympathicotonia after the ultrasound exposure. Statistically significant changes were found in of the Electrophotonic EPI/GDV parameters before and 40 minutes after the ultrasound exposure.

Conclusions: Our experimental results prove that diagnostic ultrasound had a pronounced impact on a person's aquatic systems. The EPI/GDV method using the Bio-well device allows the detection of the effect of diagnostic ultrasound on the human aquatic systems, allowing us to recommend this device for the evaluation of such effects on the human body. This opens up perspectives for the use using of the Bio-Well device to assess the impact of various medical technologies, both diagnostic and therapeutic, on the human body.

Keywords: diagnostic ultrasound, heart rate variability, Electrophotonic Imaging.

Introduction

The term "aqua-system" in relation to the human body was first proposed in[1], as the description of the aqua systems of cells, tissues, and organs. We propose a broader definition of aqua system of the body by including all fluids, such as sweat, blood, lymph, cerebrospinal fluid, saliva, urine, and intracellular and intercellular water of all tissues and

organs.

The dose of ultrasound is difficult to quantify. The action of the vibration stops the moment the ultrasound is turned off. The time required to restore the normal functioning of the cells may be up to tens of minutes[2]. A number of methodological issues arise while assessing the impact of diagnostic ultrasound on a person. Owing to the nonlinear effects of ultrasound on aquatic systems, there is no equivalent parameter for predicting the effects of ultrasound, in particularly long-term effects.

Ultrasound is not perceived directly by human senses, it is not possible to determine the level of energy received by a patient, as it depends on the type of apparatus and diagnostic modality method, and the doctor's qualifications and experience[3]. The effect of ultrasound on the operators of ultrasound devices has not been physically explored.

The most studied physical effects of ultrasound that cause unwanted effects are the mechanical and thermal effects[4]. There is a cavitation effect when the ultrasound pressure exceeds a certain limit. An essential aspect is that the level of ultrasonic power needed for heating tissue by 1°C depends on the type of tissue[2]. The consequences of the above-mentioned effects of ultrasound exposure are uncontrolled chemical reactions in the area of wave propagation that may influence chemical processes in the body. Ultrasound increases cell membrane permeability and accelerates diffusion processes, the hydrogen-ion concentration changes in tissues, causing a cleavage of high-molecular compounds, thus accelerating metabolism[5].

In addition to the release of mechanical energy, the formation of cavitation bubbles is accompanied by the appearance of electric charges on the boundary surfaces, causing luminescence and ionization of water molecules, the formation of free radicals, and hydroxyl radicals.

Chemically, the decaying products of ionized water molecules in the tissues of the body are extremely active. This high activity leads to a number of biological effects under the influence of ultrasound[5]. For example, the ultrasound increases nitrogen solubility in water by 12%[6], which can affect the dynamic network of hydrogen bonds among water molecules. Polymorphic changes in almost all tissues, organs, and systems of the human body under the influence of high-frequency ultrasound have been mentioned in several studies[1-4].

Ultrasound may have a negative effect on the health of doctors. For example, in the Chuvash State University, in Russia, the health of 85 doctors of ultrasonic diagnostics was studied: many violations were revealed, including those in the cardiovascular, nervous system in the form of dysfunction of vegetative centers dysfunction, and the changes in the macro- and microelement composition of blood serum in the form of reduced iron, phosphorus, calcium and chloride[7].

The aim of our work was to study possible effects of diagnostic ultrasound on the state of meridians of traditional Chinese medicine (TCM), the state of the autonomic nervous system, and the aqua system of people.

Materials and methods

To assess the influence of diagnostic ultrasound the following methods were used:

1. Ultrasonography with ultrasound scanner DP-9900 Plus Mindray (Korea);
2. Akabane test (thermo acupuncture) with “Reflexomaster PM-01” device (Russia);
3. Cardiorhythmography with “Expert-01” device (Russia);
4. Electrophotonic imaging (EPI/GDV) with Bio-Well device (USA);

The Akabane test consists of measuring the heat sensitivity of the end points of different meridians, situated on at the hands of a person, and reflects the asymmetry of the temperature sensitivity of the right and left fingers, related to the particular meridian[8].

The result depends on the subjective response of the patient, like "no feelings– I feel" during the test. In the Akabane test, only the time until the “I feel” response in the symmetric points is compared. There is an imbalance in the channels in which the response time of the left and right sides differ more than twofold.

In the HRV method, the heart rhythm is recorded, followed by with a subsequent mathematical analysis of its structure. The main HRV indexes are discussed in[9].

Electrophotonic Imaging EPI (GDV bioelectrography) is already in use in 62 countries, with great success in many fields[10-13]. This effect occurs when an object is placed on a glass plate and stimulated with a high-intensity electrical field, resulting in a visible glow produced by the gas discharge. This glow is detected by a sensitive CCD camera and processed in the computer as a digital image. In the EPI technology, images captured of all 10 fingers of each human subject provide a set of quantitative parameters, which may be used for statistical analysis and practical applications. EPI applications are being developed[10-20] in different areas.

The parameters of the image generated from photographing the finger surface under electrical stimulation create a neurovascular reaction on a part of the skin, influenced by the nervous-humoral status of organs and systems. Owing to this, the images captured on the GDV/EPI register an ever-changing range of states. In addition, the EPI readings of most healthy people vary only 8–10% over many days of measurements, indicating a high level of precision in this technique.[10-13.]

A total of 134 people aged between from 14 and 65 years were surveyed— all of them by the EPI method; 51 people with the Akabane test (45 women and 6 men), and 15 people (of 22 to 46 years, 14 women and 1 man) with the HRV test. The distribution by sex and age is presented in Table 1. All people were apparently healthy, without serious chronic problems and health complaints; arterial pressure, measured before the test, was within the normal range for all the participants.

All participants were explained the test procedure and they signed an informed consensus. The protocol of the experiment was approved by the ethics committee of the

Academy of Hirudotherapy.

People were advised not to eat, smoke, drink coffee or strong tea 1.5–-2 hours before the examination and not to take a deep breathe, cough or swallow during the HRV measurement. A survey of patients was conducted during the first part of the day in a darkened room by eliminating emotional arousal factors, including conversation and phone calls. Women were measured in the inter-menstrual period. Before the measurement, patients rested for 5–-10 minutes in a horizontal position. The HRV study included a 5-minute ECG recording (no less than 300 cardiocycles) in the supine position with quiet breathing. After this, GDV testing was performed, lasting for about 3 minutes.

During ultrasound test patients lay on the their stomach, the ultrasound sensor was positioned on the back in the lumbar area, and kept there for the duration of the entire experiment. After initial 10 minutes, the ultrasound signal was turned on for 10 minutes and then turned off. Patients were measured before, immediately after, and 40–-60 minutes after the application of ultrasound.

Results

As a result of experiments using the Akabane test, imbalance in some channels was observed among all subjects after exposure to diagnostic ultrasound — the most pronounced changes being seen in the meridians of the bladder (V), kidney (R), spleen-pancreas (RP), stomach (E), large intestine (GI) and lungs (P) (Fig.1). Changes in the meridian system returned to its original state in most cases within one hour. With these results, a method was developed to determine the impact of diagnostic ultrasound on the body in real time[21].

Analysis of HRV data demonstrated a shift in indexes to the pronounced sympathicotonia after the ultrasound exposure: SDNN — standard deviation of all NN intervals — decreased; PAPR — adequacy of regulation processes –increased; SI — the index of regulatory systems tension — grew; AMo — the number of RR intervals in the unit range — was enhanced; and there was a rigidity of rhythm and reduced heart rate variability.

It was shown that after the work with ultrasound, the rigidity of the cardiac rhythm was much greater expressed among the operators of the ultrasound device than among for patients subjected to ultrasonic examination. Parameters began returning to the initial values after about one hour. The detected changes were seen as a presence of a large number of rigid and the increased amount of short chains of shock waves of the first, second, and third orders.

Statistically significant changes of in the Electrophotonic EPI/GDV parameters before and 40 minutes after the ultrasound exposure are presented in the Tables 2. A significant difference was found in the GDV-grams of different fingers for the following indexes: area, normalized area, energy, intensity, and internal noise. (description of the

parameters is given in[10-13]). For most participants, they increased after the exposure, while the stress index and form factor decreased. This can be seen as a sign of activation of a person's aquatic system due to the impact of low-intensity ultrasound. Changes in these indexes for different sectors of the fingers, corresponding to different organs and systems of the body in accordance with the data of Bio-Well software, are presented in Table 3.

We may conclude from the results shown in Table 3 that the areas of the body, in which statistically significant differences before and after exposure to diagnostic ultrasound was found, were situated in the projection of the bladder channel. Of all the channels, the bladder meridian (V) has the largest length. It originates at the inner corner of the eye and ends on the foot. According to the concepts of traditional Chinese medicine[22], Channel V is functionally connected to the channel of the kidneys; so, we may conclude that it reflects the influence of the ultrasound on all body fluids.

Electrophotonic technique enables the tracking of the changes of in EPI area index over time. This signal is taken from the standard cardio electrode positioned on the right wrist of the patient. Fig. 2 demonstrates examples of time dynamics of the EPI area index before, during, and after the application of the low-intensity ultrasound.

As we see from Fig. 2, reaction to the ultrasound was different: in most of the of people, the EPI area index increased while in some it people it decreased. No dependence on age or gender was found.

Controlled experiments, imitating the process of measurements, but without application of the ultrasound, demonstrated no significant changes in the measured parameters for all applied technologies.

Discussion

As can be seen from all this data, a person's aquatic systems demonstrate pronounced response to exposure to ultrasound. The nature of the response suggests the occurrence of a wave process: during the first hour of observation, we could noted the appearance of four to five peaks in the time dynamics of the luminescence area of people subjected to ultrasound.

We can assume that active generation of free radicals in the aquatic systems takes place in the contact zone of the ultrasound sensor with tissues. Given that the whole aquatic system is joined united by a network of hydrogen bonds, it can be assumed that sweat on the surface of terminal phalanges of fingers react to the impact in the lumbar region.

As was shown in[11] , Electrophotonic signal strongly depends on microcirculation of fingers and, in particular, on the level of perspiration. This was confirmed by the experiments in the Russian institute of Hydrodynamics. The authors conducted model experiments of corona discharges stimulation according to the EPI/GDV method on multiple artificial capillaries made of polymethylmethacrylate with an inner diameter of 50

μm filled with an aqueous solution of NaCl. Photos of glow on the fingertips and on artificial capillaries looked similar[23]. The authors concluded that the observed glow on the contour of the fingers of a person was strongly depended on corona discharge in the open pores of the sweat glands.

In[24] , a group of volunteers drank water with a high negative value of the redox potential (RP), up to hundreds of millivolts. This water in a closed container retains its properties, including the negative RP value in the range -400/-200 mV for at least 6 months. This resulted in the highly reliable differences in the EPI/GDV parameters before and after drinking this water. For all volunteers, an increase in the luminescence area was observed. The detected increase was tracked for 14 days for eight of the 20 subjects (40%) who took this water daily.

All these results confirm the idea of the importance of the human aqua system for body functioning. Water is sensitive to the acoustic and electromagnetic effects, which may affect the cluster structure of intracellular water, and water entering the structure of meridians. It is shown that the acoustic signal can cause a wave resonance in a person's the aquatic systems.

Our results illustrate the need for more careful handling of diagnostic ultrasound, especially in the early stages of pregnancy. It is known that organogenesis occurs in 6–-8 weeks of pregnancy. Strong external influence at this stage may cause teratogenic effects. It should be noted that the risk of ultrasound in early pregnancy has been demonstrated in experiments on animals such as pregnant mice and chimpanzees[25,26]

Conclusions

1. The results of our experiments prove that diagnostic ultrasound has a pronounced impact on the aquatic systems of a person. This study is especially relevant for assessing the risk involved in ultrasonography for the fetus in early pregnancy and for assuming that it is it as one of the causes of occupational diseases of doctors using ultrasound diagnostic and therapy.

2. The EPI/GDV method using the Bio-Well device allows detection of the effects of diagnostic ultrasound on the human aquatic systems, which allows us to recommend this device for the evaluation of such effects on the human body.

3. The obtained results allow a significantly extension the diagnostic interpretation of the Electrophotonic information, particularly in monitoring of the impact of any influences on the human body, both therapeutic and professional. This opens up perspectives for the use of the Bio-Well device to assess the impact of various medical technologies on the human body.

4. The obtained results should be considered as preliminary and need confirmation at the next level of experiments.

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