



The neuromodulative role of earthing

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ABSTRACT

Neuromodulation is a process of inhibition, stimulation, modification and regulation or therapeutic alteration of activity, electrically and chemically in the peripheral, central or autonomic nervous systems. Direct electric current or electric field alternates the function of nervous system. Coupling the human organism with the Earth directly or via a wire conductor changes the electric potential not only on the surface of the body but also inside it, changing the potential of electric environment of the human organism. Earthing refers to a direct contact with the Earth with bare feet or contact with the Earth with the use of conductive wire attached to the human body during sleeping, or daily activities. During earthing this electric potential equals to electric potential of the Earth and the value of it depends on location, time, atmospheric conditions, moisture of the surface of the Earth. The earthing which changes the density of negative charge in electric environment of the human body influences physiological processes. Our medical hypothesis states that contact with the Earth (earthing) directly or via a conductive wire plays role as a neuromodulative factor, probably primary, which enables the nervous system to be better adapted to the demands of organism and ambient environment. It helps to restore natural, electrical status of the electrical environment of the organism and thus the nervous system. Earthing generates immediate changes in electroencephalography (EEG), surface electromyography (SEMG), and somato-sensory evoked potentials (SSEPs). We hypothesize that earthing through its complex action on bioelectrical environment of human organism and alternations in electrolyte concentrations regulates correct functioning of the nervous system. Earthing significantly influences on the electrical activity of the brain.

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Introduction

Neuromodulation is a process by which substance, neurons or neural networks excite, inhibit or tune adjacent or remote neurons or neural networks in order to deliver responses, which are better adapted to the demands of organism and more suitable for ensuring successful survival [1]. It is a process of inhibition, stimulation, modification and regulation or therapeutic alteration of activity, electrically and chemically in the peripheral, central or autonomic nervous systems. Neuromodulation involves electrical phenomena. Electrostimulation of deep structures of brain or spinal cord with alternating currents of voltage from 0 to 10 mV modulates the neurons in order to inhibit pain stimuli transmission or to interrupt the circuits responsible for tremor, rigidity or spasticity. Electric currents or changes in electrical potentials in neural networks induced by neuromodulative devices change the function of neurons in order to alleviate the symptoms of movement disorders or diminish the pain. Thus currents flowing under the potential difference in neural networks have features of neuromodulative factors [1]. Transcranial direct current stimulation is a technique that creates

a modulatory change in the electrical neurons and is a method of neuromodulation which enables to alternate the function of nervous system under the influence of direct current flowing through the brain, what improves for instance motor function [2]. Coupling the human organism with the Earth directly or via a conductor changes the electric potential not only on the surface of the body but also inside it changing the potential of the electric environment of the human organism. Earthing of the human organism is associated with the change of electric potential measured in different points of human organism. During earthing this electric potential equals to electric potential of the Earth or very close to it and the precise value of it depends on location, time, atmospheric conditions, moisture of the surface of the Earth. The earthing which changes the density of negative charge in electric environment of the human body influences on human physiological processes. According to one of the studies connection of the organism to the Earth is associated with an immediate fall of the electric potential to approximately -200 mV measured in different points of human organism in a given time and place of that experiment. Interruption of contact with the Earth causes the electrical potential to return to initial values [3]. Contact with the Earth can occur directly by walking barefoot on grass, moist soil, sand, gravel and concrete – land surfaces which are relatively good conductors of electric current,

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or during swimming in the sea and other natural water reservoir. Indoor earthing is achieved easily by connecting the body via a conductive wire to a metal rod pushed into the soil outside or to a properly grounded (earthed) outlet in a wall electric socket. Individuals can wrap a wire around the ankle or use conductive bed sheets, mats and bands (earthing.com). Walking barefoot is a process in which alternating themselves – the contact and interruption of contact with the Earth occurs. This interrupting contact causes changes in electric potential of the electrical environment of the organism, including nervous system. These electric changes are not neutral for the nervous system. Earthing generates immediate changes in EEG, SEMG, blood pressure and causes changes in physiologic processes what is reflected in biochemical parameters of calcium-phosphate, electrolyte homeostasis, glucose metabolism and endocrine and immunological systems. It also decreases the inflammatory reaction and free-radicals activity, diminishes pain [4–9].

Medical hypothesis

Our medical hypothesis states that contact with the Earth (earthing) directly or via a conductor plays role as a neuromodulative factor, probably primary, which enables the nervous system to be better adapted to the demands of organism and ambient environment. It helps to restore natural, electrical status of the electrical environment of the organism and thus the nervous system. Lack of this factor may contribute to various disorders which are the result of the lack of connection with the Earth which is a battery supplying in an appropriate electric potential essential for living and proper functioning of the nervous systems.

Empirical data

Experiments conducted by Chevalier et al. have shown that contact of the organism with the Earth is responsible for abrupt alterations in values of electroencephalogram from brain hemispheres (EEGs) and abrupt changes in values from surface electromyograms (SEMGs). Earthing significantly influences the electrical activity of the brain and muscles. There is an overall decrease in activity at all frequencies with crisp change showing on the left side what was documented in the study above [5]. Other studies have documented positive impact of the earthing on normalization of functioning of autonomic nervous system [6]. Our pilot study conducted on two participants of the experiment who were connected to the Earth documented abrupt changes in amplitude of the values of somatosensory evoked potentials (SSEPs) caused by stimulation of median nerves abruptly after connection to the Earth. Earthing was accomplished using earthing mat (earthing.com) connected through the wire to the grounding system of an electric socket. We observed abrupt fall in SSEPs amplitude immediately after barefoot contact with the mat. Later on, these values returned to initial ones.

Consequences of the hypothesis and discussion

Contact of human organism with the Earth directly or via a conductor changes the electric potential of the electric environment within the entire human organism. Alternations in electric potential of aqueous, extracellular environment effect in modulation of bioelectrical processes. The coupling of the human body with the moisten surface of the Earth evokes a rapid change in values of electric potential in venous blood, tongue, nails and teeth. In up-and-down movement of an insulated human body there are transient changes in electric potential measured in these points. In earthed subject during the same movement values of this potential

remain constant [3]. Under the earthing charge does not merely remain on the surface of the body and neutralize surface positive charge but also enters the tissues. Transmitted the Earth potential has a direct impact on the density of negative charge in the electrical human environment. A variety of mechanisms of electrolytic charge transfer take place within organism [10]. Electrochemical potential of aqueous, electrical environment can change the electrochemical proton gradient across the cellular membranes [11]. Changes in membrane potential alternate permeability for various ions and substances changing the function of targeted cells. Voltage-gated channels play important role in excitable cells such as neurons. Changes in activity of these channels and changes in membrane potential may be elicited under electrical field stimulation [12]. Local alterations in the charge profiles around voltage-gated channels can lead to electrical instability of the cell membrane and to the inappropriate spontaneous activity observed during certain pathological states such chronic pain and epilepsy [13–15]. Empirical data presented above indicate that coupling of the organism with the Earth does not remain neutral for nervous system since this contact changes the parameters which serve for monitoring of nervous system and diagnosis of disorders in function of nervous system [16,17]. We hypothesize that earthing through its complex action on bioelectrical environment of the human organism and alternations in electrolyte concentrations regulates correct functioning of the nervous system. Present lifestyle and modern habits isolated people from the Earth' energy making us more vulnerable to stress and illnesses. According to people, who experienced earthing during night or day, earthing improves sleep, increases energy, lowers stress, promotes calmness, reduces anxiety, relieves muscle tension and headaches, protects against environmental electromagnetic fields (EMFs). Several reports indicate that it also may have impact on the course of neurodegenerative and demyelinating diseases, pain syndromes, psychotic syndromes and disorders of autonomic nervous system. Contact with the Earth regulates activity of sympathetic nervous system influencing on cardiac pacemaker system, peripheral vascular system and motility of gastrointestinal systems [4]. It improves heart rate variability, a crucial indicator of a healthy autonomic nervous system [18]. Empirical data showed that earthing significantly influences on the electrical activity of the brain. Neuromodulatory effects of earthing may be observed in disorders associated with pain, in epilepsy where electrical hyperactivity of selected nervous cells take place, in spasticity, in movement disorders. Earthing may thus offer a substantial role in prevention or alleviation of symptoms of neurodegenerative and demyelinating diseases. There is urgent need for exploration of this phenomenon. Several novel studies must be done which will elucidate the mechanism of action how direct contact with the Earth or via a conductor influences on human organism and especially nervous system.

Conflicts of interests

None declared.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.mehy.2011.07.046](https://doi.org/10.1016/j.mehy.2011.07.046).

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