

Universal mechanisms of cardio- and vasoprotective action
reflexology

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SUMMARY

The review article analyzes the universal mechanisms of reflexotherapy action. In physiological and biochemical experiments on the whole organism, isolated hearts and strips of resistive arteries of animals, it was shown that stimulation of acupuncture points by various physical factors increases the activity of opioid, antioxidant and other stress-limiting systems, reduces the release of corticosterone into the blood during stress, and forms cyto- and cardio-protective effects, preventing or limiting functional and structural hyperadrenal damage. Clinical studies have demonstrated significant antihypertensive, anti-ischemic and antiarrhythmic effects of reflexotherapy, the effect of increasing the body's resistance to physical and emotional stress in healthy people and patients with cardiovascular diseases.

Key words: reflexology, stress, adaptation, cardio-protective effect, cyto-protective effect.

RESUME

Universal mechanisms of action of reflexotherapy are analyzed in a survey. In physiological and biochemical experiments on the whole organism, on isolated hearts and strips of resistive arteries of animals it was shown that stimulation of acupuncture points by different physical factors increases activity of opioid, antioxydantion and other stresslimiting systems, reduces emission of corticosteron in blood at stress, forms cyto- and cardio-protective effects, warns or limits functional and structural hyperadrenal damages. In clinical researches n significant hypothensive, antiishemic and antiarrhythmic effects of reflexotherapy, effect of increase of resistance of an organism of healthy and sick persons with cardiovascular diseases to physical and emotional stress was shown.

Keywords: reflexotherapy, stress, adaptation, cardio-protective effect, cytoprotective effect.

The problem of studying the mechanisms of action of reflexology (RT) is

a practically inexhaustible area of scientific and practical development and improvement of the methodology and technologies of this classic direction of traditional medicine, which has found its current modern embodiment and is widely used. As evidenced by numerous studies [1, 6, 9, 28, 29, 33, etc.], the effect of RT methods is provided by the formation of both specific reactions of the body, determined by the characteristics of the technologies used, their modality, localization, intensity, duration of exposure to acupuncture points (TA), etc., which, as a rule, are studied in detail in the development of one or another RT method, as well as a complex of nonspecific universal reactions, which, to a greater or lesser extent, are formed when using a variety of RT variants,

The traditional oriental concepts of the mechanisms of action of the methods of Zhenjiu therapy, in modern literature more often referred to as methods of reflexology, are based on the idea of the existence of a system of regulation of the body's activity unknown before in European medicine, which is based on circulation through the so-called "channels" or "meridians", some kind of vital energy. Its harmonious circulation, carried out in accordance with strict, complex laws, ensures the coordinated functioning of organs and body systems. According to these concepts, acupuncture points (TA) are the zones of the most active energy exchange between the human body and the environment,

The system of these concepts, for all its complexity, is very harmonious, dialectical, considers the human body in its inextricable connection and interaction with the environment, however, the existence of its main structural and functional components still needs correct evidence-based objectification.

At the same time, based on the results of numerous studies based on the data of modern clinical and physiological, neurophysiological, neurochemical, morphological, biophysical and many other studies, a fairly integral system of views on the fundamental mechanisms of the formation of sanogenetic reactions of the body that arise during treatment -prophylactic use of various modifications of RT.

In accordance with these ideas, with all the variety of specific reactions to the use of various options and methodological approaches of RT, the repeated course use of its procedures is accompanied by the emergence and gradual deepening of a complex of universal regulatory and functional-structural changes aimed at

mobilization of endogenous mechanisms of protection of the body's structures from the influence of adverse factors, improvement of the regulation of its functional systems, including the cardiovascular system, and restoration of the disturbed and maintaining the optimal state of homeostasis in general.

According to a number of studies, the structural and functional basis for the formation of such mechanisms is the emergence, in response to the stimulation of TA by physical factors of different modality, of a chain of complex sequential reflex reactions - local reaction, axon reflex, segmental reaction and general generalized reaction arising from the spread of the flow of afferent impulses from stimulated peripheral receptor zones corresponding to one or another TA, into regulatory structures located in various segments of the spinal cord, in the brain stem, centers of autonomic regulation, subcortical and cortical parts of the central nervous system [1, 5-7, 9, 14, 34].

One of the key mechanisms for the formation of such a holistic response, as was found in a number of experimental and clinical studies, is an increase in response to TA stimulation of the power of the central and local stress-limiting systems of the body and correction of the activity of the neurohumoral, hormonal and neurotransmitter regulation systems. It has been shown, in particular, that this kind of stimulation has an activating effect on opioid-, serotonin-, dopamine-, GABA-ergic stress-limiting systems and a modulating effect on the activity of the pituitary-adrenal, adrenal and cholinergic systems of regulation of body functions in general and cardiovascular system in particular [2, 4-7, 9, 19-21, 24, 28, 32]. Thus, in a series of experimental studies [24, 25, 28] it was found that that conducting a course of electroacupuncture (EAP) significantly increases the content of beta-endorphin in the blood of animals and met-enkephalins in the heart and adrenal glands, while reducing the content of adrenaline in the adrenal glands. It turned out that an increase in the production of opioid peptides significantly limits the body's response to experimental stress, determined by the release of the stress hormone corticosterone into the blood, significantly reducing stress-induced impairments of cognitive functions and structural damage to organs in animals [2, 10, 23]. It has been shown that the course of acupuncture stimulation, regardless of its modality (electroacupuncture,

and increases its resistance to stress in experimental myocardial infarction [2], and also limits the size of the zone of necrotic lesions in infarction [25].

According to [25, 32], the course of TA stimulation prevents stress depletion of glycogen stores in the heart, impairment of energy production processes responsible for ion transport and, in

In particular, the removal of calcium ions from the cells of the myocardium and blood vessels, which is necessary for the process of their relaxation, reduces its excessive accumulation in cardiomyocytes and limits the occurrence of stress-induced contractures and cardiac arrhythmias.

It was also shown that a course of TA stimulation causes persistent changes in reactivity in resistive arteries, which was expressed in a decrease in their vasoconstrictor responses to norepinephrine and in a significant increase in both endothelium-dependent vasodilation caused by acetylcholine and vasodilation caused by the beta-agonist isoproterenol [17 22, 32, 33].

As studies have shown [20, 25, 33], an important result of acupuncture stimulation is the formation of pronounced not only regulatory, but also organo- and cytoprotective effects. Evidence of the realization of this kind of influence of the course stimulation of TA is that these effects were revealed not only in experiments on the whole organism, where their occurrence is well explained by the mobilization of central stress-limiting systems and the limitation of damaging hyperadrenal reactions through this mechanism, but also in isolated, i.e. .e. organs and tissues devoid of central regulatory influences - an isolated heart and isolated strips of resistive arteries [17, 20, 25, 30,33]. According to the results of these studies,

An important evidence of the realization of the cytoprotective and cardioprotective effect of TA stimulation is the phenomenon of prevention of the occurrence of the "reperfusion paradox", the essence of which is the occurrence of arrhythmias and contractures during the period of restoration of blood supply, revealed in studies both on the whole organism [30] and on isolated hearts of rats [20] myocardium after a long period of ischemia. It is known that the emergence of a complex of reperfusion damage to the heart is largely predetermined by the release of large amounts of catecholamines from the adrenergic structures of the heart during reperfusion, activation of lipid peroxidation, accumulation of their under-oxidized products and the resulting damage to the lipid layer of cardiomyocyte membranes and, as a consequence, massive entry into calcium ion cells, the excess of which plays an important role in the development of contractures and arrhythmias [15]. It turned out [20] that in isolated hearts of animals receiving EAP, during their reperfusion after 20-minute total ischemia, the occurrence of episodes of ventricular tachycardia usually developing under these conditions was completely prevented, the number of extrasystoles decreased by 3 times, the degree of structural

myocardial damage, assessed by the release of creatine kinase into perfusate.

In a special series of studies devoted to the study of the effect of AP on the state of the antioxidant system and its antihypoxic effect [18], it was found that the course of AP leads to the mobilization of antioxidant defense mechanisms, the prevention of a 65–70 % of the activity of the antioxidant enzymes catalase and superoxide dismutase, and a significant decrease in the degree of accumulation of lipid peroxidation products in the heart, brain, liver, lungs and muscles. At the same time, the resistance of experimental animals to the damaging effects of acute hypoxia increased after the course of AP by about 1.5 times.

There are also data in the literature that after AP there is an activation of the synthesis intensity in lymphocytes [11] and in human myocardial cells [37] of stress proteins that perform reparative functions in the genetic apparatus of cells when it is damaged by various pathogenic factors.

Thus, the data presented in this section indicate that the achievement of the protective effect of AP is largely associated with the mobilization of local mechanisms of cellular, gene and organ defense against damaging influences.

In general, the results of these series of experimental studies indicate that the course of TA stimulation is accompanied by the formation of mechanisms of action that ensure the activation and increase in the power of the complex of central and local stress-limiting systems and the limitation of both excessive, damaging hyperadrenal effects on cellular structures and organs in general. and an increase in the resistance of these structures to stress, hypoxic, toxic and other damage.

The outlined mechanisms of RT action are universal, nonspecific and are realized to a greater or lesser extent when using TA stimulation by physical factors of different modality and intensity, using methodologies based on modern and traditional ideas about the mechanisms of RT action [5, 7, 22, 11, 23, 30, 34, 36]. As shown by comparative studies [18–20, 24–28, 32], nonspecific mechanisms of action of RT methods are inherently adaptive and reproduce the main mechanisms of adaptation of the organism to repeated effects of mild short-term stress, which are well studied in modern physiology [15].

The data of clinical and functional studies indicate that the experimentally revealed universal mechanisms of action are also realized when using RT methods in clinical practice.

Thus, it was shown that the use of various RT technologies makes it possible to achieve in healthy people and patients with essential hypertension (HD), ischemic heart disease (IHD), patients with cardiac arrhythmias (HRV), a significant improvement in the psychoemotional state, an increase in the degree of synchronization of bioelectric brain activity with a decrease in the level of nonspecific activation of the cerebral cortex, limiting the degree

emotional response to stress, increasing the energy efficiency of the functioning of the cardiovascular system and the resistance of patients to the dosed psychoemotional and physical stress presented to them [8, 22, 23, 26, 27, 35, 36]. Biochemical studies have shown that RT for patients with various psychosomatic diseases is accompanied by the normalization of serotonin and endorphins in the blood, reduced before treatment, and restorative correction of the function of the pituitary-adrenal and sympathoadrenal systems. Thus, in the blood of these patients after RT, the initially increased concentration of cortisol, ACTH and aldosterone decreased, and the severity of the reaction to stressful situations, assessed by the level of urinary excretion of adrenaline and norepinephrine, significantly decreased [22, 23, 26, 27, 36].

The realization of the stress-limiting effect of RT, the improvement of the autonomic provision of the function of the cardiovascular system was accompanied by a pronounced improvement in the clinical condition of patients - restoration of the impaired ratio of the parameters of central and peripheral hemodynamics, restoration of the impaired function of baroreflex regulation of the activity of the cardiovascular system, normalization of blood pressure, and a decrease in the degree of hyperfunction of the heart. at rest and during psychoemotional and physical exertion, a significant decrease in the mass of the hypertrophied myocardium in patients with hypertension [12, 21, 26, 27, 35]. An important result of such treatment is revealed according to the data of polycardiographic, echocardiographic and rheovasographic studies - improvement of the parameters of relaxation and contraction of the myocardium and peripheral vessels in patients with diseases of the cardiovascular system. In combination with the normalization of blood pressure and an improvement in the energy efficiency of the heart, this led to the restoration of its full pumping function, a decrease in the specific peripheral vascular resistance, an improvement in arterial blood flow and venous outflow in the distal parts of the extremities. The performers of these studies associate the achievement of these results with the limitation of excessive hyperadrenal effects on the cardiovascular system under the influence of RT, the restoration of impaired ion transport processes in myocardial cells and smooth muscle cells of the vasculature,

Studies [13] showed that the course of RT for the treatment of metabolic syndrome in patients with hypertension and insulin-independent diabetes mellitus reduced the degree of distyroidism through a decrease in sympathetic influences on the thyroid gland, which was expressed in a decrease in the secretion of thyroid hormones and a slowdown in the conversion of T4 to T3. and thus led to a relative decrease in the activity of one of the important factors of counterinsular action involved in the regulation of carbohydrate and lipid metabolism. At the same time, RT had a double effect on the endocrine function of the pancreas - stimulating on B cells and depressing on A cells, which led to the restoration of the disturbed insulin / glucagon balance and

to normalize glycemic levels. At the same time, these patients showed a significant decrease in the content of cholesterol, β -lipoproteins and triglycerides in the blood. Thus, it was shown that the restorative correction of the autonomic status and the normalization of the endocrine status and indicators of carbohydrate and lipid metabolism is another important mechanism for realizing the positive effect of RT.

Thus, an analysis of the data of experimental and clinical studies available in the literature, devoted to the study of the mechanisms of the sanogenetic action of RT methods in cardiovascular pathology, makes it possible to distinguish the following sequence of reactions that naturally develop during repeated, course application of TA stimulation by factors of different modality.

The emergence of a local reaction in the area of stimulated TA is accompanied by the activation of a whole complex of biologically active substances that cause vasoactive, immunoreactive reactions, the emergence of a flow of afferent impulses to the overlying regulatory structures, which together is an important component and trigger mechanism for the formation of a general generalized, in essence, adaptive reaction of the body. providing mobilization of central and local stress-limiting systems, restorative correction of disorders of hormonal regulation of autonomic functions, disorders of carbohydrate and lipid metabolism and improvement of tissue metabolism, an increase in the energy efficiency of the cardiovascular and other functional systems and an increase on this basis of their resistance to the action of stressful damaging factors and an increase in the functional reserves of the body as a whole.

Taking into account the well-known phenomenon of the so-called "cross adaptation" [15], it seems logical that during the course RT, the already mentioned increase in the resistance of the organism and the cardiovascular system, in particular, not only to psychoemotional and physical stress, but also to the effects of a number of unfavorable or damaging environmental factors - acute hypoxia, toxic effects, etc. [16–20, 24, 26, 27, 32]. The implementation of these universal adaptive mechanisms of action, along with specific reactions associated with the peculiarities of the use of different modifications of RT, largely determines the good results,

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