Some promising technologies in reflexology

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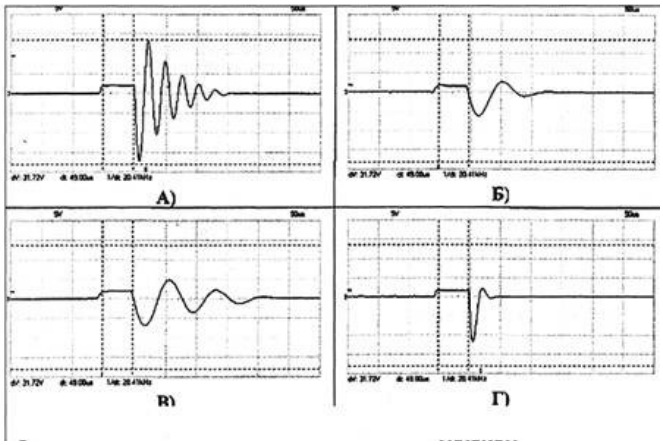
Since the second half of the 20th century, traditional acupuncture (zhen-chiu therapy) has gradually transformed into a wide variety of reflexology methods that have received modern scientific substantiation and require new hardware to be executed. Various methods are currently widely used in medical practice and are being improved [2, 5, 9, 12].

Dynamic electroneurostimulation (DENS) is a further development of traditional methods of reflexology. The method consists in exposing acupuncture zones and points with short current pulses, the shape of which is sensitive to changes in the impedance characteristics in the subelectrode area of the skin.

In the course of previous studies [8] with modeling the electrical parameters of the skin, it was found that the output pulses of a group of dynamic electrostimulators consist of two phases. The first phase of the pulse has a fixed amplitude and adjustable duration in the range from zero to several hundred microseconds. The intensity of the impact (more precisely, the energy stored in the transformer core of the apparatus) is determined by the pulse duration in the first phase. The second phase of the pulse is a transient process in the form of forced oscillations, the parameters of which are largely determined by the energy of the first phase of the pulse and the load. The amplitude of the second phase of the pulse is an order of magnitude higher than the amplitude of the first - and is the most sensitive part of the signal to changes in load. As established,



Rice. 1. Oscillograms of the output pulses of the "AKUSKEN"
apparatus at various load options (active - R and reactive - C):
A) without load: R = ∞, C = 0; B) R = 20 kΩ, C = 2.2 nF; B) R = ∞, C = 2.2 nF; D) R = 20 kOhm, C = 0

DENS is carried out using devices with built-in and external bipolar electrodes (Fig. 2).

There are still few data from experimental and clinical studies that allow us to assume that the therapeutic effect of DENS, as in electroacupuncture and transcutaneous electroneurostimulation (TENS), is based on multilevel neurohumoral reactions that trigger a cascade of regulatory mechanisms in the body [4, 7, 13].

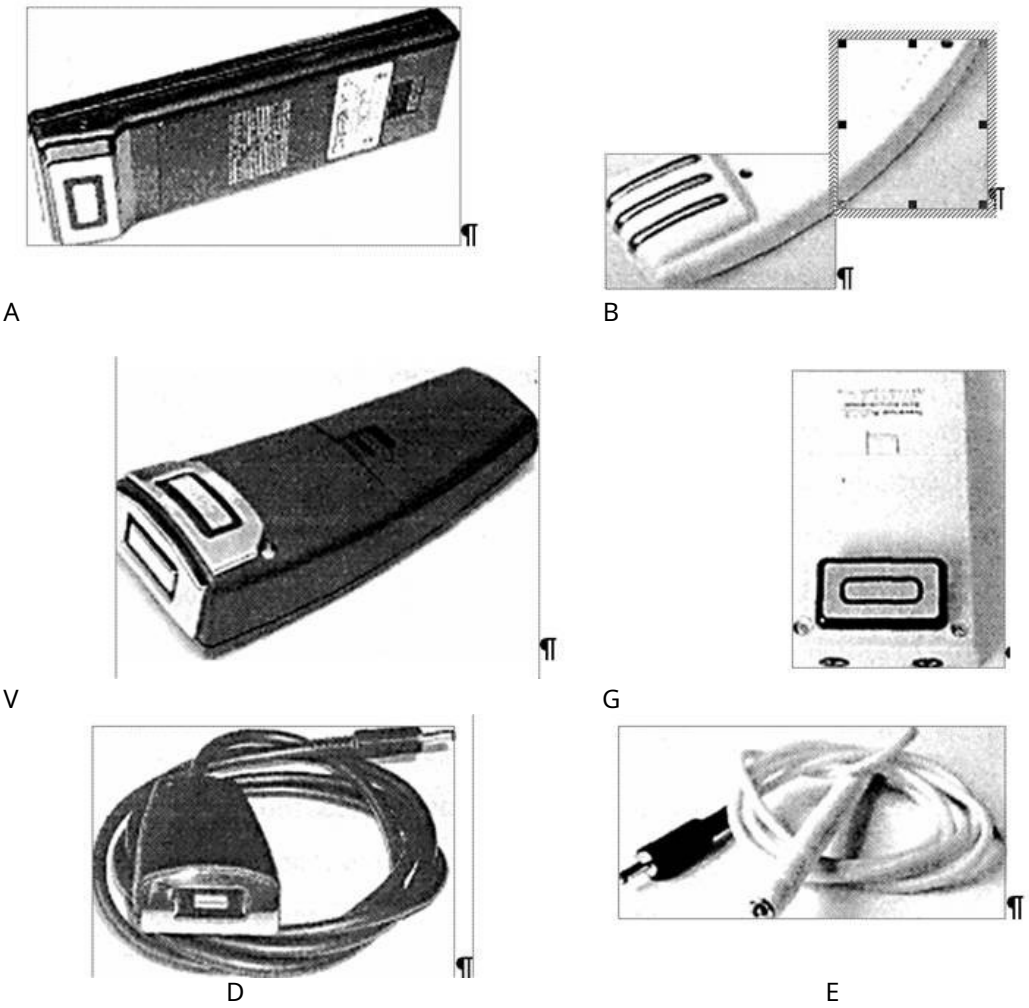


Fig. 2. Forms of built-in and removable electrodes of the devices: A) "SCENAR"; B) "DENAS"; C) "AKUSKEN"; D) "TINER"; D) remote zonal electrode; E) remote point coaxial electrode

In the domestic literature, electrostimulation is also often understood as the processes of electric current excitation of the neuromuscular system [1, 3]. With DENS, electrical impulses mainly affect sensitive afferent conductors, therefore, muscle contraction is practically not observed in the course of treatment.

The term "dynamic electroneurostimulation" was proposed based on the peculiarities of this method of electrotherapy, Firstly, because of the response of the apparatus to the dynamics of changes in the nature of the load in the form of controlling the parameters of the output stimulation pulses. And, secondly, given the ability to move the therapeutic electrodes built into the devices and affect the reflexogenic fields of a large area, the word "dynamic", which is close in meaning to dynamics (gr. Dinamikos - referring to force, strong), is interpreted as a change in what -or phenomena under the influence of factors acting on it, including those associated with movement, action [10, 11].

The use of appropriate devices allows DENS to be carried out according to "focal" and reflex patterns. In this case, during treatment, a stable technique is used (without moving the electrodes) and / or labile (with moving the electrodes). A stable technique is used when acting on acupuncture points, small reflexogenic zones and pathological foci. Labile is used in cases where the area of the field of action or pathological focus exceeds the size of the therapeutic electrode. In the labile version, the stimulator electrodes are smoothly, without separation from the body surface, moved along the affected area at a speed of 0.5 to 2-3 cm / s. Movements are carried out in straight, spiral and other movements, depending on the size and shape (relief) of the treated area. Therapeutic effects can be carried out without "burdening"

or with a slight compression - massage. Determination of the intensity of electrical stimulation is carried out individually. It is noteworthy that when using separate devices, a noticeable "secondary effect" is observed, in the form of vibroacoustic effects associated with the vibration of the output transformer core. It is noted that the vibroacoustic effect contributes to a better mental adaptation of patients to electrotherapy and ensures the "softness" of the treatment.

It is known that there is a sufficient number of skin areas on the body that are sensitive to the occurrence of dysfunctions of internal organs, on the one hand, and to the use of physical healing factors, on the other hand. Under the influence of stimulation of reflexogenic zones, compensatory reactions arise that restore the homeostatic balance of the body. At first, nervous reactions predominate, providing an immediate regulatory effect, which then continue with the participation of the humoral factor in order to maintain and prolong the initial response in time.

During the treatment sessions, it is recommended to influence the Zakharyin-Ged zones and the Williamsky zones, the cervical-collar and lumbar regions, along the muscle-tendon meridians, in the direction of the lines - for superficial (multi-needle) acupuncture, mini-acupuncture systems and acupuncture points. The composition of the zones and points for treatment, as well as the "dosage" of the effect, are determined by the patient's clinical condition and his reactivity. It is important to note that a number of devices have a "dosed" mode of exposure, however, from our point of view, because of its insufficient physiological justification, it may be advisable to use the vasomotor reaction of the skin - the occurrence of hyperemia at the sites of exposure. The exception is the developed apparatus "DiaDENS" (series "DENAS"),

Unlike TENS, which is mainly a symptomatic means of pain relief in combination with analgesics, DENS already has a fairly wide range of medical applications. It is obvious that further development of dynamic reflex technologies is also promising, in particular, on the basis of modern concepts of systemic and antisystemic principles of organization and regulation of body functions [6].

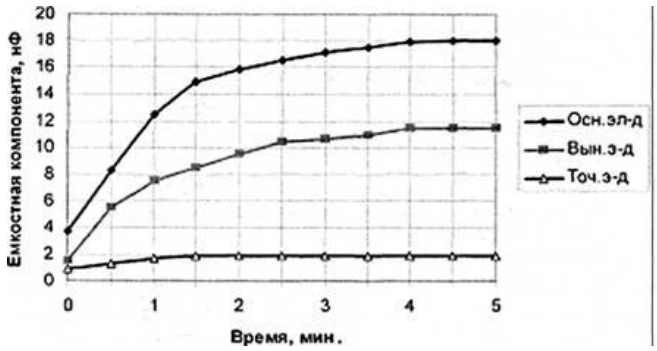
The dynamics of influencing signals can be provided in different ways, for example, by introducing modes of amplitude-frequency modulation of output current pulses, etc., but within limited limits determined by the physiological reactions of the body's systems. It is assumed that variation of stimulation parameters in combination with a labile method of exposure increases the effectiveness of reflex treatment by reducing tolerance, adapting receptors and nerve centers to electrical stimuli, and the area and number of treated skin zones [9]. DENS can be attributed to the modern implementation of the known methods of labile reflexotherapy along with the traditional ones: superficial acupuncture, and cupping massage, pinch therapy of the spine, etc.

In order to expand the medical application of dynamic electrostimulators, they can be completed with sets of various electrodes and attachments; acupuncture, dental, proctovaginal, etc. These nozzles are electrodes of various designs and shapes, designed to affect acupuncture points and mucous membranes, for example, mouth, rectum, vagina. In this regard, the question arises about the possibility of using devices for percutaneous dynamic electrotherapy for intracavitary stimulation. Therefore, we carried out studies aimed at studying the dependence of the capacitive component of the skin impedance on the area of the therapeutic electrode, as well as the peculiarities of its variation on the oral mucosa.

For these studies, we used a VELLEMAN PCS500 digital oscilloscope, a C1-99 oscilloscope, a TES 2360 digital tester and samples of the SCENAR, DENAS, AKUSKEN and TINER devices.

As shown earlier [8], the capacitance values when the skin is touched with a therapeutic electrode change in an increasing order with a gradual plateau. The plateau is reached in most cases within the first 5 minutes from the moment of touching the skin. The studies carried out made it possible to establish that the steepness of the increase and the value of the capacity differ in different subjects, as well as in the same person in different parts of the body. When analyzing the capacity value in symmetric zones on the "healthy" and "affected" side, differences in this indicator were revealed in all patients.

In this work, a similar result was obtained for other types of electrodes for percutaneous electrical stimulation. In fig. 3 shows the graphs of the change in the value of the capacitive component of the surface impedance of the skin using three forms of bipolar electrodes when touching the skin (without electrical stimulation): the main zonal, the remote zonal (10 mm in diameter) and the remote point (3 mm in diameter). It can be noted that the nature of changes in the magnitude of the capacitive impedance component is the same. Only the absolute values differ, which are proportional to the area of the gaps between the conductors of the bipolar electrodes, which basically determines the value of the capacitance, taking into account the dielectric constant.

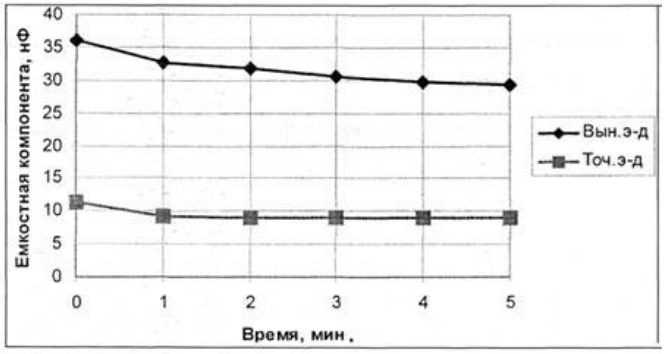


Rice. 3. Graphs of changes in the value of the capacitive impedance component when touching the skin with three different types of electrodes

The results obtained indicate that when assessing the impedance of the skin surface, for example, to determine the "dosage" of exposure, it is imperative to take into account the design features of each connected electrode.

A completely different character of changes in the value of the capacitive impedance component was observed on the oral mucosa. In fig. 4 shows the graphs of the change in the capacity value when touching the oral mucosa (without electrical stimulation) when using two types of bipolar electrodes: external zonal (10 mm in diameter) and external point (3 mm in diameter).

First, when the electrodes touch the mucous membrane, an instant increase in the capacitance value is observed from 0.1 nF (the electrode's own capacitance) to values of several tens of nanofarads, which is proportional to the area of the gap between the conductors of the bipolar electrodes and the dielectric constant of the solution on the mucosal surface. In this case, it can be noted that for the main built-in electrode, the upper value of the increase in the capacitance value reached hundreds of nanofarads. Secondly, there was a gradual decrease in the value of the capacitive component over time, which is apparently caused by the evaporation of moisture from the mucous membrane with the subsequent stabilization of this process.



Rice. 4. Patient A., 47 years old. Graphs of changes in the magnitude of the capacitive impedance component when touching the oral mucosa with two different types of electrodes

When the electrodes touched the mucous membrane during electrical stimulation, it was found that the tested devices are not very suitable for these purposes because of the relatively "rough" control at low amplitudes and because of the high sensitivity of the mucous membrane to electrical stimulation. It was also found that the active component of the impedance is less than the critical one, at which there are no forced oscillations in the second phase of the output current pulses, according to which, as a rule, the “dosage” of the effect is determined. In addition, the critical load led to distortions in the pulse shape in the first phase. For the reasons listed above, the dynamics of changes in the capacitive component of the impedance during electrical stimulation of the mucous membrane was not evaluated,

Obvious differences in the nature of changes in impedance parameters and in their orders of magnitude when exposed to mucous membranes, as compared to transcutaneous electrical stimulation, limit the direct use of devices and electrodes for intracavitary procedures. The exception is the TINER apparatus, which has a mode for cavity stimulation. Therefore, the development of new devices or special modes with more suitable load characteristics for these purposes is required. In addition, the algorithms for determining

The "dosage" of exposure should be based on an impedance estimate, taking into account the design features of each applied therapeutic electrode. The nature of impedance changes and the range of values during electrical stimulation of the mucous membrane differs from these values during percutaneous stimulation.Consequently, additional research and application of new principles of circuitry solutions are required when solving the problems of expanding the medical use of dynamic electrical stimulators.

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