

Electrostimulation methods

Electromagnetic field

It is a physical field corresponding to the degree of mutual interaction of electric and magnetic force in space. It therefore consists of an electric and a magnetic field.

Electric field - a space in which the action of an electric force manifests itself.

Source of electric field:

- electrically charged body,
- time-varying magnetic field.

'Types of electric field:

- non-stationary electric field - general, time-varying electric field;
- stationary electric field - time-invariant electric field;
- electrostatic field - a special case of a stationary field in which there are no electric currents.



Electrotherapy for back pain

Effect of magnetic field on living organism

Magnetomechanical effect - changes in orientation and concentration, especially in diamagnetic molecules, result in changes in the kinetics of many biochemical reactions and other physicochemical events. All this leads to changes in macromolecules and bipolar water molecules contained in the organism.

Magnetohydrodynamic effect - affects the blood flowing in the blood vessels, resulting in a decrease in the speed of blood flow at the site of action. This effect increases with increasing diameter of the vessel and, of course, with increasing intensity of the magnetic field.

The magnetoelectric effect is based on the formation of so-called induced potentials. Although these potentials, arising in the organism as a result of the action of the magnetic field, are relatively small, they cause changes in the membrane potential of the cells and thus primarily affect the nervous system.

Note: The above applies to stationary and non-stationary low-frequency magnetic fields. The biological effects of high-frequency magnetic fields are based primarily on the mechanism of conversion into thermal energy and are used in practice, for example, in ultrashortwave diathermy.

Effect of an electric field on a living organism

The effects of electric current also vary greatly depending on its type.

Direct current passes primarily through the extracellular fluid. It takes place through the tissue as the movement of ions, i.e. electrolytically. Direct current has an irritating effect only during changes, i.e. switching on and off. (changes → involuntary muscle contraction - spasm) The resistance of different tissues varies greatly - the best conductors are blood, cerebrospinal fluid, muscle and nerve tissue. On the contrary, bones, for example, have very low conductivity. At a constant intensity, it does not irritate, but it can change the irritation → electrotonus (used in galvanotherapy).

Alternating current passes through the organism as a so-called sliding current, i.e. based on the rotation of dipolar molecules in the direction of the polarity of the electric field in the rhythm of the half-period of the current. These movements generate a large amount of heat. Depending on the frequency and intensity used, it has either an irritating, trophic or analgesic effect. The therapeutic effect is thus influenced by the amplitude, frequency, shape and modulation of the impulses and the type of tissue.

The effects of alternating current therefore depend greatly on its frequency:

- Low-frequency currents - irritating effects (up to 100Hz).
- High frequency currents - thermal effects (higher than 100 kHz).

Galvanotherapy

More than 2,500 years ago, the ancient Egyptians used electric eel discharges. However, the name galvanotherapy was created in honor of Luigi Galvani (1737-1798).

Galvanotherapy - a therapeutic procedure using direct (galvanic) current. This current has a constant intensity, but its disadvantage is the danger of chemical damage to the tissue under the electrodes. Therefore, intermittent galvanic current is used for treatment, which has the same effects but is better tolerated by patients.

Application - in a water environment, where the limbs are immersed each in a separate tub, each connected to one electrode - anode or cathode. The electrodes have a plate shape and a standard pad impregnated with a protective solution. The area between the electrodes is called the current path. In this area, the so-called eutonization of the capillary bed occurs, i.e. the gradual polarization of the tissue (i.e. the generation of voltage of the opposite polarity), which is detected by the organism as a serious disturbance of the internal environment, which the organism solves by maximally increasing the capillary blood supply - by relaxing the capillary sphincters. However, if there are pathologically dilated sphincters in the flow path, they contract.

Types of galvanization - the position of the electrodes (or the size of the electrodes), water temperature, application time, number of procedures, voltage intensity always depend on the type of injury. We also distinguish several forms of galvanization:

- static galvanization
- electrotherapeutic bath
- Iontophoresis

Effects and treatment- galvanotherapy is used to treat the musculoskeletal system - post-traumatic or post-paralytic conditions, to treat tendonitis, muscle pain and degenerative diseases of the musculoskeletal system. It helps to speed up metabolism, increase blood circulation and has analgesic effects.

Alternating current therapy

Low frequency currents

Low-frequency currents have a frequency of up to 1000 Hz and tend to be irritating, trophic and analgesic.

1. **Diadynamic currents** - diadynamic currents (discovered by Pierre D. Bernard, 1929) are the simultaneous application of a galvanic current and a pulse component, after which the current is named. The effects of diadynamic currents depend mainly on the intensity, less on the type of pulse component. At suprathreshold sensitive intensity, DD currents have an analgesic effect, at subthreshold motor intensity they cause muscle contraction. It can be used for myostimulation or myorelaxation.
2. **Träbert currents** - a low-frequency, monophasic, rectangular pulse current, sometimes called a 2-5 current because the pulse length is 2 ms and the pause length is 5 ms. Due to its significant analgesic effect, this current is used for pain in the neck, back, head and limbs.
3. **Transcutaneous electrical neurostimulation (TENS)** - point application of electrical impulses to a complex of painful changes and to specific reflexogenic zones with a cushioned blunt needle electrode.
4. **Faradization** - the term faradization includes an imprecisely defined group of pulsed currents with a frequency from 30 to 100 Hz, described without subjective intensity or with subthreshold motor intensity. Physiological effects depend on the subjective intensity, frequency and duration of the impulse.
5. **Electrostimulation** - stimulation of peripheral motor neurons or striated or smooth muscles. Electrostimulation is used to maintain good blood circulation, prevents thrombosis and is also used to prevent muscle hypotrophy after injuries or operations. As part of electrostimulation, we distinguish pulse currents with a fast onset, which are used in electrogymnastics (training healthy muscles so that they do not weaken), and pulse currents with a slow onset, which we use for selective electrostimulation of denervated muscles and stimulation of smooth muscles.
6. **Cardiopacing** - is used to maintain the heart rhythm in physiological values by means of. A cardiostimulator is used for cardiac stimulation and is used in the case of cardiac automation transmission disorders.
7. **Defibrillation** - restoring proper heart function by the effect of an electric shock from a defibrillator. It is used for ventricular tachycardia or ventricular fibrillation.
8. **Electroshock** - passage of current through the brain in the treatment of depressive states and schizophrenia. For the application, clamp electrodes are used, which are placed on the temples. After application, several minutes of unconsciousness, striated muscle spasms and amnesia may occur.
9. **Neurostimulation** - is used to suppress intractable pain by stimulating the spinal cord with a neurostimulator.
10. **Electrically stimulated breathing** - used in acute breathing disorders, when the phrenic nerve, which innervates the diaphragm, the main inspiratory muscle, is irritated.

Medium frequency currents

Medium frequency currents have a frequency of 2500 Hz to 12,000 Hz. They do not contain a galvanic component, thus there is no corrosion and it is possible to apply these currents for a longer period of time.

1. **Interference currents** - two currents of medium frequencies directly in the tissue, one electric oscillating circuit delivering a constant frequency of 5000 Hz to the tissue, the other circuit has a fluctuating frequency in the selectable range from 5001 to 5100 Hz. At the intersection of the two circles, a low frequency is applied as interference, which is determined by the difference in the frequency of the two alternating currents and ranges from 1 to 100 Hz. Low frequencies (5-20 Hz) have a rather irritating effect and tone the neuromuscular apparatus. Higher frequencies (50-100 Hz) have a dampening effect, relax muscle contractions and have an analgesic effect.
1. **Kotz currents** - medium-frequency currents with a frequency of 2500 Hz. They are used to treat weak muscles after surgery or to treat paralysis.

High frequency currents

High-frequency currents have a frequency above 100,000 Hz. They are without irritating effects thanks to the short-term action of the current, but they have thermal effects.

1. **Diathermy** - deep heating by direct conversion of the energy of the high-frequency electromagnetic field into the internal energy of the tissues. When heating tissues, the principle applies that the shorter the wavelength, the more intense the heating of tissues. The heating of tissues depends on their physical properties and their blood supply. The highest heating is at the interfaces between tissues, which are strongly different from each other in acoustic impedances. Diathermy causes expansion of the vascular bed, improvement of tissue nutrition, suppression of pain. It is used in the treatment of chronic diseases of the musculoskeletal system and blood circulation disorders.
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 1. *Short-wave diathermy* - high frequencies where a conductive connection between the electrodes and the organism is not necessary, the heated tissue is a dielectric. Application: by condenser field (overheating mainly in the subcutaneous tissue → diathermy of the abdomen, joints, chest or parts of the limbs). By the induction field of the spiral (heating in the electromagnetic field → acts on the muscles). Pulse application (local heating occurs).
 2. *Microwave diathermy* - a device called a magnetron that emits strong magnetic waves. Microwaves set electrically charged particles into oscillating motion, which is transformed into heat by friction. Application especially in ophthalmology, otorhinolaryngology, etc.
 3. *Ultrashortwave diathermy* - (Ultrasound - US) biological effects of ultrasound vibrations. It uses the conversion of acoustic energy into heat. The system consists of two main parts: an HF electric current generator and an application head of its own ultrasound source consisting of a piezoelectric transducer.
2. **Induced currents** - arise in tissues exposed to electrotherapy carried out by high-frequency currents. Above all, we are talking about eddy currents, which are sometimes referred to as Foucault currents after their discoverer. However, the human body does not have such conductivity as, for example, copper, aluminum and brass. The result is that free electrons in a massive block of conductor (in our case, human tissue) begin to move in circles under the influence of a variable magnetic field (hence the name eddy currents), and part of their energy is converted into thermal energy (Joule heat). This causes the tissue to heat up. Eddy current losses are highly frequency dependent and can be expressed as: $P_V \sim f^2 B^2$, where B is the magnetic induction and f is the frequency. In addition to these two quantities, losses are also affected by the thickness of the material.
3. **High-frequency electrosurgery** - cutting and coagulation of tissues using high-frequency alternating current.

Links

Related Articles

- Electrotherapy
- Use of electricity in therapy

References

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