Micro-invasive recovery of central nervous system and peripheral nerves

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There are many orthopedic, rheumatologic and neurological pathologies associated with impaired function of peripheral nerves. In practice the treatment of such pathologies traditional surgical and therapeutic methods are insufficient effective. The method of restoring sensory and motor functions of the central nervous system and peripheral nerves is an alternative to treatment after failure of the latter. The result is achieved using the claimed method is the high efficacy of the therapy in case of defeat to 90% of nerve synapses, allowing to achieve a complete cure of the patient and reduce the time of rehabilitation, as well as the possibility of outpatient treatment and absence of contraindications.

The claimed technical result is achieved through the implementation of ways to restore function of the central nervous system and peripheral nerves, which consists in the fact that the treatment is carried out in three stages:

a) Implanting in the nerve at least two hollow electrodes proximally and distally (above and below) to the nerve injury site. The hollow electrodes are typically made of a biologically neutral conductive material; usually stainless steel alloys are used. As electrodes can be used catheters for puncture of the spinal cord.

b) Course extracorporeal focused shock wave therapy (F-SWT), consisting of at least five sessions with electrical stimulation, designed to stimulate axonal growth peripheral nerve fiber regeneration and forming the myelin sheath of Schwann cells - at this stage, the formation of new synapses peripheral nerves;

c) Removing of implanted electrodes is used, at least one session with electroneuromyography to coordinate a newly formed synapses peripheral nerves.

The main difference between the claimed method for the recovery function of the central nervous system and peripheral nerves of other known methods is in a controlled accelerated regeneration of neurons in highly enriched culture in the injured nerve, which allows for rapid and uniform growth of axons towards each other with simultaneous synchronization nerve synapses, and accordingly to create conditions for full recovery of sensory and motor nerve function.

Combination therapy for the treatment of the first step of treatment comprises implantation two or more hollow electrodes in the nerve (amount is defined by the length of the defect rate of the nerve tissue at the two electrodes each 5-6 cm of the damaged nerve) above and below the site of injury. This manipulation is performed under aseptic conditions - operating or procedure room. If the open wound surface, convenient to carry out the invasion of electrodes during visual inspection, otherwise implantation is performed under ultrasound-shots. Electrodes should be introduced into the nerve at a depth of 0.5-1cm, fixed to the skin and closing sterile adhesive antibacterial wipes. Through hollow electrodes drip directly into the nerve of the drug solution with simultaneous connection of electrical apparatus and drug iontophoresis. Hollow electrodes remain in the patient for the entire course of therapy. The success of the first phase of treatment is determined by the results of repeated ultrasound images of the affected nerve, which is determined by the accuracy of invasion electrodes.

In the second stage of treatment used, at least one course focused extracorporeal shock wave therapy, consisting of 5 to 20 sessions, in conjunction with intraneural electrical stimulation and iontophoresis, aimed at stimulating the growth of axons of peripheral nerve fiber regeneration. The number of sessions is depending from the results of electroneuromyography. Rates continue to until saved increasing the positive dynamics of the affected nerve electrical impulse.

Method focused extracorporeal shock wave therapy (method F-SWT) based on short-time (0.1-0.3 seconds) application to the field of disease-focused low-frequency sound wave shock. F-SWT improves local circulation and loosens fibrotic lesions affecting the normal reunion damaged axons of nerve cells. One of the major effects of the shock wave is to stimulate the development of new microvasculature in the problem area.

Theoretical aspects of the F-SWT based on the creation of a shock wave with high flux density, which focuses on a limited target area. This is to ensure that the shock waves will develop a complete energy exclusively for the treatment of selected site without damaging the surrounding tissues. Hyperbaric effect F-SWT based on the ability to form a cavity acoustic vibration in the tissues, F-SWT produces micro-massage, which is very important in the treatment of edema.

In the acute phase of inflammation, shock waves facilitates removal of tissue histamine and prevents the formation of other risk factors

in the cells that is associated with an increase in the diffusion of calcium ions across the cell membrane. The result of this process is to reduce the intensity of inflammation in the tissues. In the granulation step of the inflammatory process stimulated by the formation of neurons as well as for fibroblasts and new collagen of the capillary network. Thus, various effects are produced on the tissue to stimulate the healing process due to intensification of the metabolic process that is used in the cases observed in neurosurgical practice for treating paralysis and paresis of the peripheral nervous system, post-operative complications, neuralgia, neuropathy, etc.

In the claimed method of restoring sensory and motor functions of the central nervous system and peripheral nerves is focused extracorporeal shock wave therapy is performed at the threshold energy. Density of energy (from 1 to 5 Mpa) and pulse frequency (from 1 to 5 Hz) is settings during the session F-SWT. If the patient begins to experience pain even when properly focused stream of shock waves, it is necessary to reduce their energy 0.5-1 MPa. It is also possible to lower the pulse frequency 1-2 Hz. Given the frequency and energy are recommended and can be varied depending on the specific circumstances.

Electrophoresis drugs (iontophoresis) - a method of introducing drugs into the body by a constant electric current through the skin or mucous membranes. In the case of interstitial (intraneural) iontophoresis electrodes and the drugs injected directly into the diseased tissue (nerve), within which is also distributed by means of a constant electric current. As a result, changes the ionic balance around the cells, accelerates the healing of skin wounds and bones recovered fibrous tissue, increases cellular metabolism and restores the potential of cell membranes, increases microcirculation. As a result of their interaction, the influence of each of these factors resulted in a qualitatively new effect is observed.

The drug solution is injected directly into the affected nerve, and the composition of the solution consists of the following drugs: Placenta compositum 2.2ml, Mydocalm 1ml, Diprospan 0.25ml, Procaine 2.2 mL. This formula of the drug solution is a special case and not to limit the claimed invention - as a drug solution can be any compound that is selected depending on local conditions, experience and preferences of the physician.

Intraneural electrical stimulation - a method of electric shocks on the neuro-muscular system. During electrical stimulation used toward permanent pulsed electrical current at low voltage (60 - 80 V) and low power (up to 50 mA), the pulses of different form and duration. Because of the rapid rise of the current processes of diffusion and osmosis do not have time to compensate for violations of ion concentration in the tissues. These disorders are greater than when exposed to a galvanic current of the same strength.

Basic physiological reactions and therapeutic effect: there is a pronounced irritant effect of pulsed electric current. The response to this stimulation – fibrillation of muscle fibers. Upon closing the circuit muscle contraction occurs at a cathode under a current of less than under the anode. Excitation of muscle activity pulsed electric current prevents the progression of degeneration reactions, acceleration and restoration of damaged nerve fibers.

In the claimed method of reconstructing the functions of the central nervous system and peripheral nerve electrodes are introduced to a depth for 0.5-1cm directly into the affected nerve, which in variably-vector mode served bipolar modulated current (6 mA 15-20 volt 25-50Hz) - it allows to evenly distribute the drug throughout the area of the nerve between the two electrodes. Duration of treatment is 45 minutes.

The success of the second phase of therapy is determined by the results electroneuromyography, which is held every fifth session of treatment. The criterion for completion of the second phase is to achieve the lower limit of the conduction of impulses according to standard tables EMNG. In the third stage of treatment is removing of implanted electrodes are used, at 5-10 session with electroneuromyography to coordinate a newly formed synapses peripheral nerves.

The described method for the recovery function of the central nervous system and peripheral nerves is exceptionally high performance even in case of defeat to 90% of nerve synapses.

According to statistics obtained by the Israel clinic «Pain Clinic Unique methods of medical treatment» based on 15-year experience of more than 5,000 patients with various neurological disorders, the effectiveness of the treatment close to 95-99% clinical and laboratory confirmation of a positive result

Amount of damaged nerve synapses before the treatment,%	Amount of damaged nerve synapses after the treatment,%
1. Less 20	1. More 95%
2. From 20 till 40	2. 90-95%
3. From 40 till 60	3. 80-90%
4. From 60 till 80	4. 60-80%
5. From 80 til 90	5. More 50%