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GRAVITY THERAPY

Guidelines for healthcare providers

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This guideline is intended for physiotherapists, rehabilitologists, surgeons, neurologists, retrainees, middle medical personnel of physiotherapeutic rooms and departments at healthcare and health resort facilities.

The guideline provides justification of the use of a new method, gravity therapy, in the treatment and rehabilitation of patients with various diseases. Features of technical characteristics of the equipment used in the republic for gravity therapy are considered, that is an inversion table for therapeutic intervention to the patients. Techniques and methods for performing procedures, as well as indications and contraindications for gravity therapy are described.

INTRODUCTION

Gravitational medicine is a combination of therapeutic methods using the force of gravity as the leading factor to achieve a clinical effect.

Gravity therapy is one of the new physiotherapeutic approaches that is based on the impact of gravity on the body at different body positions relative to the vector of the effect of this force.

The new method has acquired special importance in the sustainable improvement of blood microcirculation. As the microvasculature is the place where the transport function of the cardiovascular system is eventually implemented and the transcapillary exchange is ensured, which creates the necessary hemostatic cutting of tissue, the correction of microcirculatory disturbances is extremely important in pathology of almost any kind, especially in cardiology, diabetology, pulmonology, and vascular surgery. In addition, the aging process of the human body is inextricably linked with the progressive disorders of organ and tissue microcirculation. In this regard, the gravitational therapy technologies that have appeared in recent years are of interest to practical and experimental medicine.

In 2016 in the Republic of Belarus, Belmedinnovation, LLC has also provided an opportunity to use gravitational effect. The company patented the innovative method of therapeutic treatment of patients and unique equipment, "Inversion table for therapeutic intervention to the patients". This guideline is written to introduce the new method of treatment, unique equipment and its therapeutic capabilities to clinicians.

JUSTIFICATION OF THE USE OF GRAVITY THERAPY

The actual physical factor of gravity therapy is modified (increased or decreased) gravity. Depending on the direction of action relative to the vertical axis of the body, longitudinal and transverse overloads are distinguished. When the direction of the overload vector is from the head to legs, it is called a positive overload, and when direction is from legs to the head, it is a negative overload. In addition, transverse (back/chest, chest/back) and lateral (side-side) overloads are distinguished. The direction of the overload vector is essential for determining the nature of the physiological responses of the body.

The primary effects determining the specificity of the action of the therapeutic physical factor include redistribution of blood and other body fluids, increased hydrostatic pressure in the vessels of the lower extremities, increased load on the skeleton and internal structures of the organism, changes in the functional state of the mechanoreceptors, gravitoreceptors, stimulation of the baroreceptors (sinocarotid area), and deformation and displacement of organs and tissues.

It is already proved nowadays that gravity therapy is an effective method of treating therapeutic, neurological, surgical, traumatological, and orthopedic patients.

GRAVITY THERAPY METHODS

The first mentions of hanging upside down as a method of treatment were discovered by archaeologists on ancient artifacts and were deciphered as the first drawings of the yoga postures (3000 BC).

Hippocrates mentioned in his teachings how he raised the patients to the stairs with a combination of belts and blocks, using the force of gravity to stretch the body and treat a disease.

In literature, there is a description of the method of applying gravity by turning the body upside down.

In modern medicine, the effects of gravity on the body under different body

positions relative to the vector of gravitational force were investigated by scientists of various medical and non-medical specialties. The influence of natural gravity on the vital activity of organisms has repeatedly attracted the attention of the fathers of physiology: I.M. Sechenov, I.P Pavlov, V.I. Vernadsky, etc.

Modern gravity therapy includes various options for using the force of gravity to treat patients.

GRAVITY THERAPY WITH SHORT-ARM CENTRIFUGE

Personnel of Samara Medical University, under the guidance of academician G. Kotelnikov, developed and introduced into medical practice a short-arm centrifuge that creates a hypergravitational effect (up to +2 G) on the patient during a short (10-15 minutes) procedure. During the gravity therapy session, in which the patient's head is on the axis of rotation of the centrifuge, the resulting centrifugal force causes an additional blood flow to the lower extremities.

The authors demonstrated that moderate values of increased gravity stimulate active growth of capillaries, thereby optimizing the osteogenesis processes in fractures of the lower extremities [2,5]. They also experimentally confirmed the beneficial effect of this method on the regeneration of muscle tissue and articular cartilage. The improvement in the blood supply to the pelvis and lower extremities observed in such treatment prevents the posttraumatic osteoporosis and deforming arthrosis, atherosclerotic vascular injury, and helps suppress inflammation. Especially impressive results of treatment were noted in traumatological and orthopedic patients. Moreover, the design features of the medical stand allow to perform the procedure in conditions of gypsum immobilization, compression-distraction osteosynthesis, and other types of metallic osteosynthesis. Preventive gravity therapy sessions conducted in patients with bone fractures of the lower extremities can optimize the regeneration of bone tissue, achieve bone union at an earlier time, and avoid complications.

GRAVITY THERAPY BY DRY IMMERSION

Another method of gravity treatment is the use of "dry immersion". It is based on modeling the zero gravity state and reducing the gravitational effect using an aqueous medium with no direct contact of the patient with water. It results in a redistribution of biological fluids in the body, reducing the weight load on the body. This method is widely used in the rehabilitation of children with cerebral palsy, mental retardation, and osteoarticular pathology. It has been shown that gravity therapy by dry immersion has a beneficial effect when recovering athletes after heavy physical activity [1,4].

GRAVITY THERAPY WITH DYNAMIC INVERSION TABLE

The possibility of using gravitational effect in the Republic of Belarus appeared due to Belmedinnovation, LLC.

Belmedinnovation, LLC registered in Minsk, Republic of Belarus (Certificate of state registration No. 0101421 issued by Minsk City Executive Committee) is the patent holder of the method of treatment and prevention of neurological, cardiological, and therapeutic diseases (Patent for invention No. 2545444), and also acts as the owner and manufacturer of the medical device "Inversion table for therapeutic intervention to the patients", which uses a patented method of treatment and rehabilitation of patients.

"Inversion table for therapeutic intervention to the patients" passed a full cycle of sanitary and hygienic examination in the state institution "Republican Center for Hygiene, Epidemiology and Public Health" of the Republic of Belarus, technical tests at the Research Center for Testing Measuring Instruments and Equipment of Belarusian State Institute of Metrology, as well as clinical trials at leading medical institutions:

- Healthcare Institution "10th City Clinical Hospital"
- Healthcare Institution "Minsk Regional Clinical Hospital"
- State Institution "Republican Research and Clinical Center "Cardiology".

- Healthcare Institution " 4th City Clinical Hospital named after N.E. Savchenko "
- Healthcare Institution "9th City Clinical Hospital"

The use of dynamic inversion table provides autogravitational effect on the human body.

GRAVITY THERAPY EQUIPMENT

"Inversion table for therapeutic intervention to the patients" is a robotic bed working a twenty-minute cycle with smooth, slow reciprocating movements in two planes, with a special orthopedic mattress, a comfortable U-shaped pillow, and a back belt for fixation (Figure 1).

The table is equipped with a patient monitor, which records the main indicators of central hemodynamics (heart rate, blood pressure, SP02, respiratory rate, ECG) during the whole procedure.

Figure 1 - Inversion table for therapeutic intervention to the patients manufactured by Belmedinnovation, LLC

MECHANISM OF THERAPEUTIC ACTION OF THE DYNAMIC INVERSION TABLE

Rhythmic changes in the angle of gravity relative to the longitudinal and transverse axes of the body mostly influence blood and tissue fluid. The change in the angle of gravity force is performed at a fixed frequency (0.1 Hz). This frequency lies in the range of vasomotion and is called the Traube- Mayer-Goering wave. It has a synchronizing effect on peripheral vascular resistance, cardiac and respiratory rhythms. In addition, it is bioeffective, i.e., the exogenous effect of this frequency causes an active response.

It is believed that this rhythm is set by baroreceptor structures, and this is done as follows: in response to the decrease in blood pressure below a certain level, the baroreceptors activate, which causes an increase in sympathetic vasomotor activity and, accordingly, vasoconstriction. As a result, the blood pressure rises, reaches a certain maximum value, and then begins to decrease. The whole cycle is repeated over and over again. The baroreflex hypothesis of the 0.1 hertz rhythm generation is also supported by the fact that with the stretching of the carotid sinus by creation of a decreased barometric pressure over the cervical region of the local area within 0.6 s, damped oscillations of the heart rate occur with a period of 10 seconds. However, there is another point of view. It comes down to the fact that the generalized sympathetic activity is set by a special oscillator located in the neural network of the brain stem. It is mainly determining the fluctuations in the intensity of the sympathetic vasomotor neuron pulse flow with a period of 10 seconds. These fluctuations are transmitted over sympathetic efferent nerve fibers to the heart and vessels, triggering the cardiac metasympathetic structures that perform the basic organ innervation. This is what leads to the generation of 0.1 hertz rhythms of heart rate, blood pressure, and peripheral resistance. In this case, heart rate fluctuations are not a consequence of blood pressure fluctuations, and the time shift of heart rate and blood pressure rhythms may be associated with different lengths of the efferent pathway.

It is possible that all three mechanisms (baroreflex, central, and myogenic)

participate in the generation of 0.1 hertz heart rate rhythm.

CLINICAL EFFECTS OF GRAVITY THERAPY USING INVERSION TABLE

Regular slow oscillations in the range of vasomotions cause redistribution of blood flow towards the upper body (similar changes in hemodynamics are observed in zero gravity state). However, since the oscillations are continuous and smooth, and the slope angle is relatively small, there is no compensatory vasospasm during the procedure in response to postural hyperemia. In contrast, there is a tendency to decrease peripheral vascular resistance.

The result of the effect is an improvement in microcirculation rates achieved by an increase in the amplitude of vasomotions, a decrease in paravascular edema, an increase in the volumetric capillary blood flow rate, and a decrease in venular stasis, as confirmed by laser Doppler flowmetry, scleral biomicroscopy, and capillaroscopy.

Evaluating the results of laser Doppler flowmetry has shown an increase in the percentage of nutritional blood flow (an increase in the number of functioning capillaries), the predominance of the active microcirculation regulation mechanisms over the passive ones.

Taking into account that according to the results of capillaroscopy performed before and after the treatment course using an inversion table the improvement in the form of structural and functional changes in the microvasculature was observed both in the area of the nail phalanges of the upper limb fingers and in the sclera area, it can be considered that the patented method of treatment has a beneficial effect on systemic microcirculation, which explains the large number of positive clinical effects in various diseases.

Benefits of an inversion table are: direct action on blood and lymph circulation; systemic effects on the body as a whole; no need for specific patient preparation; training effect on the cardiovascular system as a result of rhythmic movement of blood and lymph; possibility to improve microcirculation in the early post-

traumatic period (the procedure can be performed with gypsum immobilization and bandages); very few contraindications (acute and critical conditions, diseases in the stage of decompensation, pregnancy, oncological diseases).

RESULTS OF CLINICAL TRIAL OF "INVERSION TABLE FOR THERAPEUTIC INTERVENTION TO THE PATIENTS"

In an instrumental examination, patients who underwent a ten-day treatment course showed a significant increase in exercise tolerance (according to the results of bicycle ergometry), normalization of arterial pressure, reduction in signs of ischemia on the ECG, and reduction in pulmonary artery pressure. During the clinical trials, the results of instrumental examinations have been obtained, which confirm the significantly higher efficacy of this method in the treatment of chronic lymphovenous insufficiency of the lower extremities in comparison with medicinal treatment and compression therapy.

Ultrasound examination revealed a decrease in the diameter of the entry and stem of the great saphenous vein (by more than 30%), an increase in the blood flow volume passing through the deep veins of the lower extremities (by more than 40%), a decrease in the thickness of the subcutaneous fat in the shin area and the rear of the foot, and increased epithelization of trophic ulcers.

Subjectively, patients noted improvement in the quality of sleep, increased work productivity, improved memory and attention, improved mood, reduced facial swelling, and the appearance of "feeling of lightness in legs".

A significant number of patients noted a significant reduction or disappearance of the long-term "tinnitus" that cannot be corrected with medicinal therapy. Also, during the clinical trials, there was a normalization of blood glucose level in patients with diabetes mellitus type 2 having hyperglycemia, which could not be corrected with medicinal therapy. Normalization of blood glucose level in patients taking hypoglycemic drugs occurred without increasing its dose. Moreover, some patients receiving insulin therapy needed a reduction in the usual dosage of the drug. Patients who experienced a stroke and were receiving treatment using

dynamic inversion table noted the improvement in sleep, memory, speech, warming of the skin on the side affected with paresis.

According to the test results, the medical device "Inversion table for therapeutic intervention to the patients" is registered in the Republic of Belarus (Registration Certificate No. ИМ-7.103706 dd. December 15, 2016) and is authorized for manufacturing, sale, and medical use.

TECHNIQUE AND PROCEDURE OF GRAVITY THERAPY USING INVERSION TABLE

During the procedure, the patient lies on the inversion table on the right side with legs bent at knees with the left foot on the long edge of the pillow. This position is required for the most comfortable condition of the patient during the procedure, it is also the most beneficial for hemo- and lymphocirculation (excludes pressure of unpaired organs on adjacent organs and main vessels, prevents the possibility of gastroesophageal reflux during the cephalic tilt) (Figure 2).

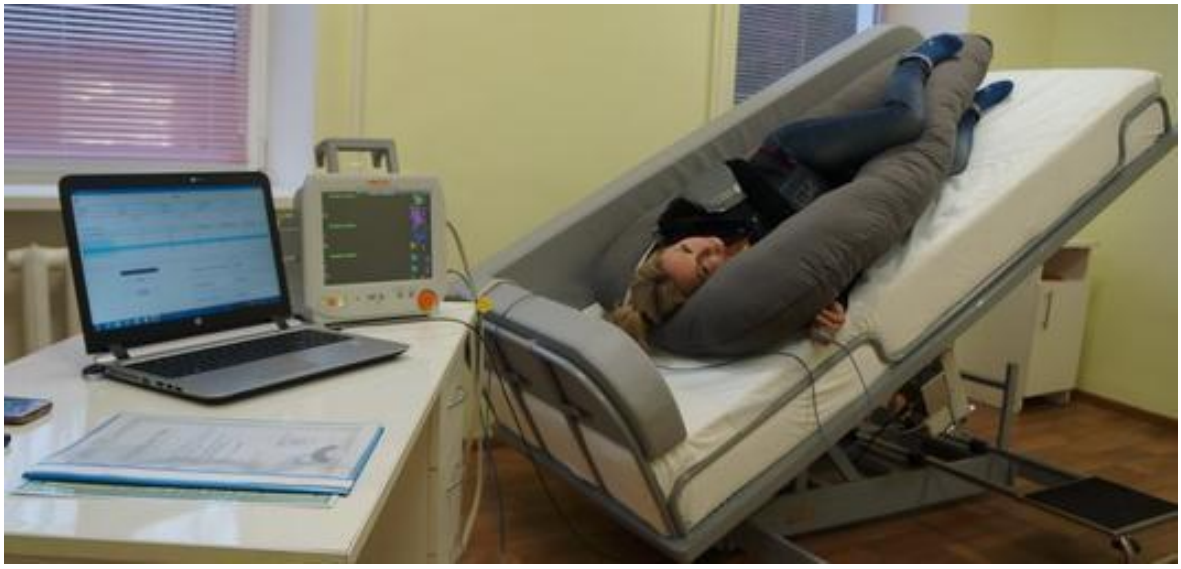

Figure 2 - Gravity therapy using inversion table

During the procedure, the lying bed surface moves very smoothly, gradually reaching an inclination towards the patient's head up to 30 degrees for 10 minutes and then comes back in the same rhythm.

The duration of the gravity therapy procedure using inversion table is 20 minutes.

To obtain a sustainable effect, there should be a treatment course consisting of 10 sessions, daily or every other day, followed by a repetition in 2-4 weeks.

INDICATIONS FOR GRAVITY THERAPY USING INVERSION TABLE

- Essential arterial hypertension
- Complex treatment of coronary heart disease
- Chronic lymphovenous insufficiency of the lower extremities
- Circulation failure in cardiological patients
- Sleep disturbance

Treatment using an inversion table may be recommended as a restorative and anti-aging procedure, as well as for improving the quality of sleep.

CONTRAINDICATIONS FOR GRAVITY THERAPY USING INVERSION TABLE

- acute and critical conditions,
- disease at the stage of decompensation,
- pregnancy,
- oncological diseases,
- bleeding of any nature,
- early postoperative period.
- It is prohibited to use this equipment in patients who are in a state of alcohol and drug intoxication, as well as in patients suffering from mental illnesses

Thus, gravity therapy is of great interest as a method of treatment of the peripheral vasculature diseases. Such features of gravity therapy as high performance, efficiency, absence of negative impact on the patient's body, as well as the possibility of combining with many physiotherapeutic factors create a great prospect of its application.

It is important that gravity therapy has a overall effect on the body, causing reflex

response in cardiovascular, musculoskeletal, and internal organs. As a result of the stimulating effect of increased gravity, the level of adaptive capacity of the organism is significantly improved. Patients, who received a treatment course, note the increase in vitality and overall well-being.

The method of gravity therapy using the "Inversion table for therapeutic intervention to the patients" is highly effective for the correction of microcirculatory disorders of various nature, which makes it promising for clinical studies and extended use (in pediatrics, neurology, endocrinology, gerontology, gynecology, pulmonology, emergency medicine, sports medicine, etc.).

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