

**DYNAMIC
ELECTRONEUROSTIMULATION
IS A MODERN TECHNOLOGY OF
RECONSTRUCTIVE MEDICINE**

**Collected materials of international symposium
devoted to 10-th anniversary
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Articles of scientists and reports of internship doctors of different specialities who presented the results of their personal researches and practical groundwork for the period of 2006-2007 years on this symposium, in the field of relatively new but high-performance and rapidly obtaining popularity, both in Russia and abroad, method of reconstructive medicine – dynamic electroneurostimulation – are published in this collection.

Publishers and editorial board have the right to have their own opinion on published materials.

**EVALUATION OF DYNAMIC
ELECTRONEUROSTIMULATION EFFICIENCY
IN PATIENTS WITH SPINE FRACTURES
IN THE PRESENCE OF OSTEOPOROSIS**

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Osteoporosis (OP) – is a systemic disease of a skeleton, which is characterized by microarchitectonics bone tissue disorder that causes an increase of bone fragility and high risk of their fractures. Spine fractures are typical for osteoporosis, these fractures are widespread and, according to Russian data research, reaches from 7.2 to 12 % in men and from 7 to 16 % in women [1, 2].

Patients with spine fractures have chronic pain syndrome and functional limitations, which causes quality of life decrease, possibility of becoming disabled, and makes them continuously appeal for medical help.

Dynamic electroneurostimulation (DENS) is one of the alternatives to drug treatment of pain, that is because impulse of alternating current is effecting biologically active points and zones, triggers neuro-humoral reactions, and anaesthetic and anti-inflammatory effects are the result of those reactions [3]. However, for the 30 years of TENS existence (transcutaneous electroneurostimulation – term that is being used in foreign literature) a little convincing data was received about its efficiency, because randomization conditions are often not fulfilled, there are not enough placebo-controlled researches. In some placebo-controlled researches unambiguous confirmation of anaesthetic effect of transcutaneous electrostimulation in patients who had pain in a lower part of the back was not received [4].

Speaking about patients with osteoporotic spine fractures, there are some indications in a literature that electrostimulation could reduce pain, but there are no evidences of its efficiency [5].

An evaluation of dynamic electroneurostimulation (DENS) impact on a pain in a back and quality of life of patients with osteoporotic spine fractures was the purpose of the present research.

Women over 50 years old with osteoporotic spine fractures, which were confirmed with X-ray, and chronic back pain were included into research. All the patients signed an informed agreement.

Patients with repeated osteoporosis and spine fractures of different etiology, patients with individual intolerance to electric current, patients with implanted heart pacemaker, patients with neoformations of any kind in the places of electrodes application were not included into research.

33 women with osteoporotic spine fractures (from 1 to 11 vertebra for some persons) and chronic back pain were randomized into 2 groups: main group consisted out of 17 people, control group included 16 people.

Patients of the main group were treated with DiaDENS-PK apparatus. An application was carried out in the area of thoracic or lumbar spine at the place of the maximal painfulness with the help of remote zonal electrode DENS-applicator. A procedure was started with the stimulation in a “Therapy” mode at 10 Hz frequency with 5 minutes of duration; right after that 77 Hz frequency was set up and application was continued during next 15 minutes. Minimal level of intensity was set up so the patient would not have any sensations. General time of the procedure was 20 minutes, procedures were accomplished daily or every other day during 10 days.

An imitation of DENS-effect was created in a control group with the help of DiaDENS-PK apparatus – placebo. A remote zonal electrode DENS-applicator was fixed on the back on the place of maximal painfulness for 20 minutes, the same way as the first time. Herewith, a notice “10 Hz Therapy” was seen on the screen of DiaDENS-PK apparatus – placebo during 5 minutes, a notice “77 Hz Therapy” was seen on the screen during 15 minutes (by analogy with DiaDENS-PK apparatus that was used for patients of the main group), however, the medical effect was not realized. Basing on their sensations, patients of both groups could not understand, if an application took place or it was an imitation of such application. A doctor that examined patients before the first session and after the course was over did not know which group – main or control one – patient belonged to, consequently, he could not voluntarily or not affect the results.

Level of DENS efficiency in treatment of pain syndrome and quality of life change were evaluated with the help of QUALEFFO-41 ques-

tioning and VAS (visual-analog scale) of pain that were filled in by patients themselves every time they visited the clinic. Scale of pain consisted of 100 divisions, where 0 points indicated absolute pain absence, 100 points indicated maximal pain. Functional indices were evaluated by means of spine mobility measuring (Otto's test, Shober's test, spine rotation) and walking test (to get up from the chair, walk 3 meters, to come back and sit down measuring time in seconds).

Patients of both groups continued to receive basic therapy of osteoporosis and concomitant diseases without the changes during all the period of the research.

Statistical processing was accomplished with nonparametric tests assistance (Wilkokson's test, Mann-Whitney test, Fisher's test). The main and the control group initially were comparable in age and all other criteria that were studied.

According to VAS back pain of patients of the main group reduced from 57.5 to 38.5 points; $p = 0.003$. An uncertain pain reduction from 63.2 to 56.2 points was observed in the control group.

A reliable pain syndrome reduction (from 3.45 to 3.19; $p = 0.02$) and physical abilities improvement, especially homework (from 2.55 to 2.28; $p = 0.01$) and mobility (from 2.38 to 2.15; $p = 0.001$), were received in patients of the main group when having QUALEFFO-41 evaluation.

There were no reliable changes on stated indices in the control group.

There were no difference between the main and the placebo group when evaluating everyday activity, general level of health and state of mind.

92 % of patients of the main group and 46 % of patients of the control group ($p = 0.02$) stated the pain reduction in the thorax when evaluating the pain dynamic. 69 % of patients of the main group and 36 % of patients of the placebo group noticed the pain reduction in the lumbar region, however, statistically significant differences between the groups were not achieved.

Mobility of the spine measuring did not demonstrate any reliable differences neither in main, nor in control group. Walking test demonstrated time reduction both in the main and in the control group.

Number of fibromyalgia points (painful points on the body) decreased after the treatment in all the patients, but the differences are not

reliable for the control group, and they are reliable for the basic group (7.58–6.29; $p = 0.03$).

Thus, the research confirmed that dynamic electroneurostimulation reduces the pain and improves the quality of life of patients with osteoporotic spine fractures, and it could be included in a complex program of treatment of such patients. It is necessary to continue the research increasing an amount of sampling.

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**DYNAMIC ELECTRONEUROSTIMULATION
IN THE SYSTEM OF ORTHOPEDIC-SURGICAL
TREATMENT OF CHILDREN WITH CEREBRAL PALSY**

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Infantile cerebral paralysis (ICP) is sufficiently widespread and complex orthopedic-neurologic disorder which is characterized by multiple contractures of joints of upper and lower extremities of complex genesis against the background of high muscle tone of central origin, up to hyperkinesias. Treatment of motor disorders of patients is carried out by means of different conservative (massage, exercise therapy, correcting putting to bed in plaster bars, physiotherapy, drug therapy) and surgical methods (reconstructive surgeries on tendomuscular and osteoarticular apparatuses of extremities). Local pain syndrome and edema of soft tissues, intensity and duration of which slow down rehabilitation measures, are frequent concurrent syndromes or consequences of performed manipulations.

We had a choice of adequate method of treatment which was capable of indicated symptomatology stopping. Adequacy to the pathogenesis of the disease, simplicity and safety of usage and possibility of continuous application not only in a hospital but also at home were the requirements for this method.

From one hand, experience of dynamic electroneurostimulation (DENS) application on different stages of rehabilitation of patients with orthopedic pathology that was available in Orthopedic children's research institute named by Turner G.I. and, from the other hand, potential possibilities of DENS apparatuses (portability, adaptability for particular patient, handleability, possibility of patients and their parents teaching) became a preconditions for development of

DENS-maintenance approach of orthopedic-surgical treatment on preoperative and postoperative stages of complex rehabilitation of children with ICP.

The purpose of the research was multi-factor evaluation of dynamic electroneurostimulation effectiveness on orthopedic-neurosurgical stages of treatment of children with ICP.

Materials and methods of the research

Over 40 children from 4 to 18 years old were getting DENS on the different stages of complex orthopedic-surgical treatment during 1.5 years in the clinic of children's cerebral palsy of Orthopedic children's research institute named by Turner G.I. Patients who received DENS on the all three stages of complex treatment (before the operation, during the postoperative period and at the time of following motor rehabilitation) were chosen for the present research. 26 children 4 to 14 years old with spastic types of ICP, 19 out of them had spastic diplegia, 7 had hemiparesis, made up a group of patients under study. Children of similar age who had similar motor disorders and did not receive DENS made up a control group.

Children from both groups were clinically examined (orthopedic-neurological status indices) before the treatment and repeatedly on the stages of postoperative motor rehabilitation.

During the preoperative period an attention was mostly paid to the muscle tone and motor activity change. Muscle tone was registered according to Ashworth scale, general motor activity was registered according to Arens scale. During the postoperative period dynamic of pain syndrome, local edema and symptoms of soft tissues trophism disorder was emphasized. Pain syndrome degree of manifestation was evaluated according to visual-analog scale (VAS). Objective and subjective indices of muscle tone and voluntary movements were evaluated on the postoperative motor rehabilitation stage.

Dynamic electroneurostimulation was carried out by means of "DENAS" and "DiaDENS-T" apparatuses. Individual program of hardware exposure was created for each patient according to methodological guidelines of DENS formulation. During the postoperative period the treatment was carried out in a "Therapy" mode at 77 or 140 Hz frequency in a form of therapy course with 6-10 sessions length, once a day, mostly in the zones of frontal projection of a complaint within 15-20 minutes in a presence of full-blown pain syndrome. The indicated treatment was carried out in a "Test" mode during the preoperative period and in the postoperative rehabilitation period. An application

was performed in a zone of frontal projection of a complaint, on the symmetrical conditionally healthy zones and in projecting zones of the corresponding segments of the spinal cord (lumbar enlargement after the operations on lower extremities and cervical intumescence after the operations on upper limbs), that is in the area of cervical spine and lumbosacral region. Treatment course consisted of 12 sessions where each of them was 20-45 minutes long. Cream “Malavtilin” was used in some cases for medical effect strengthening.

The results

Statistically significant changes were not revealed in the observable joints before and after DENS course in the preoperative period analyzing amplitude indices of active and passive movements. At the same time, subjective signs of some spasticity level decrease were observed. The results of questioning of the parents confirm this fact: movements performing facilitation was noticed at the time of therapeutic exercises practicing and in the everyday life in 38% of cases (10 people). General motor activity increase was detected in 46% of children (12 people). Reduction of local vegetative disorders in a form of hyperhidrosis and extremity coldness which is typical for children with ICP was observed in 9 out of 26 children (34.6%) after the course that included DENS of reflexogenic zones in a projection of cervical and lumbosacral part of spinal cord.

Dynamic electroneurostimulation that was applied directly after operative interventions, was prescribed for children in order to cut off the pain syndrome and affect postoperative edema of soft tissues starting on the 2-3 day after the operation. Medical effect approached already after the first session, after 3-5 sessions indicated phenomena were cut off completely. In case of significant postoperative edema of soft tissues, as it was noticed, DENS procedures were carried out directly in the edema area, in the sclerotome areas and in the projection areas of corresponding segments of the spinal cord. Edema symptoms in the wound area disappeared after 3-4 sessions.

Stimulation of motor activity of a child as well as cutting off a pain syndrome, that appeared as a result of movement development in a limb after a surgery, were the purpose of DENS at the postoperative rehabilitation stage. Significant reduction of reflex muscle hypertone which was evaluated according to Ashwort scale was registered in all patients

at this stage. Spasticity in the femoral muscles (flexor and extensor muscles of tibia, adductor muscles) during the treatment reduced more distinctly than in gastrocnemius muscles.

During the research of dynamic of muscle pain syndrome at the post-operative rehabilitation stage its reduction up to 5-6 points according to VAS was registered, which means it was poorly apparent or even disappeared completely. Herewith, distinctive reduction up to 3-4 points was observed already in the first 2-3 days after the treatment was started. Steady anesthetic effect was registered, in average, after 8-10 sessions (in some cases it was necessary to extend the treatment up to 14 sessions).

Thus, DENS application at the stages of complex orthopedic-surgical treatment of children with ICP is effective and clinically demonstrated the following:

1) DENS results are expressed in some balance of central and vegetative nervous system, subjective signs of spasticity reduction (38%), general motor activity increase (46%) in a complex of conservative pre-operative treatment;

2) DENS significantly effects pain syndrome in the early postoperative period and on the stage of motor rehabilitation of a patient with ICP;

3) Psychological mood of a patient and his/her mother changes which makes doctor and patient cooperation easier, positively results in the rehabilitation measures realization;

4) DENS causes distinctive reflex muscle hypertone reduction which assists other motor rehabilitation measures quality improvement at the postoperative rehabilitation stage;

5) Technical characteristics of DENS apparatuses allow to perform procedures at home which could cause reduction of a length of hospital stay of a patient and increase of economic effectiveness of a treatment.

The results of an approach developed indicate that wide application of DENS-maintenance of orthopedic-surgical treatment of children with ICP is reasonable.

**NEUROPHYSIOLOGICAL RESEARCH RESULTS
UNDER DYNAMIC ELECTRONEUROSTIMULATION
FOR CHILDREN WITH INFANTILE
CEREBRAL PARALYSIS**

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Different effects become apparent in the process of dynamic electroneurostimulation (DENS) application; significant ones are anesthetic, anti-edematous, anti-inflammatory, vasodilating and spasmolytic when implementing conservative and operative treatment of children with infantile cerebral paralysis (ICP). High muscle tone and motor function disorder as a result of central nervous system affection are differential clinical syndromes of infantile cerebral paralysis. However, existing clinical observations of positive DENS impact on the functional state of neuromuscular apparatus of children with ICP were not accompanied by neurophysiology methods till present time.

Purpose of the research was analysis of dynamic electroneurostimulation impact on the state of neuromuscular apparatus of patients with ICP during complex orthopedic-surgical treatment.

Materials and methods of the research

A research of contractile function of dorsum and lower extremities muscles was carried out using the method of global electromyography (EMG) in 25 patients with infantile cerebral paralysis in the age from 4 to 14 years old. 5 persons out of them were examined on the all stages of treatment including preoperative preparation, postoperative period and rehabilitation period. 12 people were examined only during postoperative period, and 8 people were examined only during preoperative preparation. Standard DENS treatment course included 10 sessions. The research was carried out before the course was started as well as after it was finished.

The research was carried out with the help of “NEURO-MVP-4” electroneuromyograph made by “Neurosoft” company (Russia) applying standard ground lead electrodes. Isometric mode with evaluation of amplitude and structural indices of electrogenesis of muscles under study in the projection of motor points was used. Longitudinal dorsal muscles on a level of thorax and lumbar region, tibial muscles (gastrocnemius muscle and anterior tibial muscle) and femoral muscles (rectus muscle of thigh, quadriceps muscle of thigh, tibial flexor muscles, adductor femoral muscle) were chosen for the research.

The Results

Electrogenesis of reduced amplitude, 50—70% lower than age norm, with saturated pattern of action potential (AP) typical for the central dysfunction of motor structures activation and muscle tone increase by pyramidal type was registered at the initial stage in the muscles of lower extremities. Structural changes typical for the moderate segmental dysfunction of lumbar enlargement motoneurons with alpha- and gamma-motoneurons activation acceleration regulation also were registered in the 85% of cases.

Decay of amplitude indices in the dorsal muscles on the initial stage was expressed less and made up 30% of the age norm; the same structural changes were registered.

76% of patients showed electrogenesis amplitude increase of studied muscles 18—22% in comparison with initial indices after DENS course. Increment of amplitude indices in the femoral muscles came to 28% for 12 patient. Electrogenesis amplitude increase in the dorsal muscles was less expressed, only 11—15% from initial data. Structural changes stayed the same.

Preliminary results evaluation of electroneurophysiological examination of patients with ICP allows to assume that changes received could be associated with evident vasoactive action of DENS. Blood circulation enhancement of ischemic tissues in the stimulation zone activates metabolic and trophic processes not only in the zone of impact, but also in the deep-underlying tissues, as well as in the zones that are segmentally connected with them. Also, reserve functional abilities of tissues are stimulated and regulating influence on the segmental and motorneuronic apparatus is exerted as a result of general humoral impact on the body.

On the ground of data received preconditions for further research of possibility of positive DENS effect on the central nervous system regulating mechanisms when having long-term exposure to the indicated therapy are created.

ROLE OF ELECTRONEUROSTIMULATION IN PREVENTIVE THERAPY OF PATIENTS OF SCHOOL AGE WITH RISK OF MYOPIA DEVELOPMENT AND PROGRESSING

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Concept of school myopia became wider in the last years. Myopia develops at the age of 5-6 years old due to earlier and more intense education, usage of computers during school process. More rapid than in previous years myopia aggravation was registered. Peaks of the disease progression fall on 7-9 and 12-14 years old periods. These age periods coincide with periods of hormonal changes in a body. In recent years an increase of nearsighted people a year makes about 5 %, in above mentioned periods and among students of gymnasiums and lyceums it could reach up to 7-10 %. Increase of nearsightedness prevalence in those children in double was caused by 6-yers old beginning of the study. Number of shortsighted schoolchildren between students of 11-th grade reaches 60 %.

Thus, there is obvious influence of excess visual load on spasm of accommodation appearance and myopia progression. At the same time, number of patients with high myopia degree does not increase significantly. Myopia of low and medium degree without serious changes in a retina could be found more frequently. This fact is an evidence of an acquired character of myopia.

Several factors could explain mechanism of such myopia development:

- continuous overexertion of ciliary muscle, its spasm;
- sclera weakness, which favours an accommodation cramp transition to axial myopia;
- worsening of blood supply of eyebulb and CNS in general. This is caused by high axial load on the spine in the sitting position, by incorrect posture. As a rule, vasoconstriction of a retina and a brain is detected, venous outflow disturbamce is revealed;

- general asthenisation of the body;
 - digestive system disorder, pathology of small intestine especially.
- Thus, there should be a complex treatment of myopia.

It makes sense to carry out a preventive treatment of children during the period of asthenopic complaints appearance due to high possibility of myopia development in a definite group of children that present a risk group (age, intense study, incorrect posture, susceptibility to frequent catarrhal illnesses, etc.)

The most effective and safe is treatment by means of physiotherapeutic procedures. Methods of magnetotherapy, electrophoresis and laser therapy have positive but very short-term effect.

Prescription of mydriatics is effective enough (iriphryn 2.5%), they relax ciliary muscle. However, this muscle will spasm later if not trained. Special exercises for eyes gives a positive effect but it should be done regularly. Therewith, infancy habits should be taken into consideration. Some diligence is required; unfortunately, it is impossible to control correctness of its application.

Dynamic electroneurostimulation method has been applied in ophthalmology since recent times. Numerous previous researches are the evidence of that fact that multilevel reflex and neurochemical reactions that start up a cascade of regulatory and adaptive mechanisms of the body underlie a therapeutic action of dynamic electroneurostimulation (DENS). As a result, pain syndromes are eliminated, blood flow is improved, anti-inflammatory action takes place, biologically active substances formation is activated, metabolic processes in tissues occur, muscle and vascular tone is normalized.

The purpose of this work is to study an effectiveness of preventive DENS in children of infancy with risk of myopia progression.

Group of patients with myopia of low and middle degree in the age interval from 7 to 16 years old was chosen. There were 48 patients altogether. This group was using DENS method in 15 sessions course in a “Therapy” mode at 77 Hz frequency at minimal comfortable level of intensity. Duration of session was 10 minutes. Duration of follow-ups of patients made up to 1.5 years. Sessions were repeated in accordance with individual indications, depending on asthenopic complains appearance. All the patients were examined thoroughly (central visual acuity determination, spare accommodation determination, biomicroscopy, ophthalmoscopy, ultrasonic diagnostics, autorefractometry).

Group of patients with myopia was observed during 2-3 years which gives an opportunity to make a comparison with the results of previous treatment courses (without DENS-therapy).

Effectiveness of treatment increased and constituted 0.5-1.5 diopter when using dynamic electroneurostimulation. Especially evident effect was received in patients with spasm of accommodation (92 %) and myopia of low degree (86 %). Reserve of positive part of accommodation increased from (-)0.5 to (-)3.0 diopters and higher virtually in all patients with accommodation cramp. 70 % of refraction normalized in patients with low degree of myopia. Reserve of positive part of accommodation normalized. For patients with medium degree of myopia an effect turned to be not that high. Myopia reduction made up 1.0 diopter in average. Reserve of positive part of accommodation increased from (-)0.0 to (-)2.0 diopters.

Asthenopic complaints were eliminated in 90 % of cases at the end of treatment.

No side effects or complications were noticed during DENS application. Therapeutic effect remained in average during 3-4 months when having myopia of medium degree and up to 6 month when having myopia of low degree. Comparative analyses of effectiveness with previous traditional therapy in the same group of patients demonstrated high percentage of myopia stabilization – near 90 %. Only 50 % of patients demonstrated stabilization previously.

Thus, DENS application for prophylaxis of myopia of low and medium degree development and treatment has an evident therapeutic effect. Course duration is about 10 to 15 days. It is necessary to select repeated courses individually and in accordance with asthenopic complaints of patients appearance and clinical examination results. Refractometry and accommodation reserve determination should be considered as main diagnostic methods. Preventive character of DENS application provides myopia stabilization. It is reasonable to apply it in groups with increased risk of myopia progression.

**EFFICIENCY OF ELECTRO STIMULATION
BY DIADENS-T DEVICE IN THE PATIENTS
WITH RETINAL DISEASES**

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Alternative medicine in the ophthalmology field is widely adopted in treatment of different pathological conditions: from dry eyes syndrome to pathology of retina, and especially, pigmentary retinopathy, gerontal central degeneration, degenerative myopia, glaucoma, optic nerve atrophy.

Purpose of our research is to evaluate an efficiency of electrostimulation with the help of DiaDENS-T apparatus in patients suffering from diseases of retina.

Materials and methods. The research was carried out in the period from May to September of year 2006; 10 patients were included into it: 8 women and 2 men; average age was 58.2 ± 17 years (27-76 years old). All the patients suffer from retinal pathology of degenerative type, particularly: pigmentary retinopathy (RP), senile direct degeneration (DMS), atrophic and vascular, glaucomal neuropathy (NOG) (table 1).

Table 1

Name	Age (in years)	Sex	Pathology
N.K.	27	F	Optical preatrophy
N.D.	35	F	Pigmentary retinopathy RP
C.R..	46	F	Pigmentary retinopathy RP
D.R.	57	F	Glaucomal opticopatia NOG
A.L.	62	F	Pigmentary retinopathy RP
L.G.	65	M	Pigmentary retinopathy RP

N.D.	65	F	Pigmentary retinopathy RP
G.F.	72	M	Vascular DMS
A.T.	77	F	Atrophic DMS
R.S.	76	F	Atrophic DMS

All the involved patients had either severely impaired vision or impaired vision of the average degree.

Criteria of the inclusion to the research: visually impaired patients with AV < 3/10 (logMAR 0.54) with the fields of view <30%; with the stable retinal pathology which existed not less than 9 months; absence of inflammatory eye diseases in an acute condition.

Elimination criteria: presence of the heart pacemaker, metal clamps or other material sensitive to electromagnetic stimulation, including the ones that are results of surgical interventions; surgical interventions in the eyes for the last 6 month.

The following examinations were done to all the patients in the beginning and in the end of treatment: acuity of vision determination (AV) into the distance and close to the object, biomicroscopy of the posterior segment, intraocular pressure measuring with the help of Goldmann device, fundus of the eye examination.

Parameters that are being estimated: AV p.1 and p.v., microperimetry (microperimeter MP-1 Nidek Technologies, Italy), fields of vision H:30 (HFA II) and optic coherence tomography (OCT II ZEISS) – in case of microperimetry implementation impossibility (single patient).

Microperimetry data, compliancy of the patients and quality of life improvement were evaluated not only in terms of visual acuity, but first of all in respect of personal everyday habits preservation and fulfilment of ordinary obligations.

All the patient were informed about an experimental character of the treatment and gave a written consent.

Patients were evaluated at the beginning of treatment (t-0); 1 week later, 3 weeks later and then 6 weeks after the treatment was started.

Patients received dynamic electroneurostimulation (DENS) with the help of DiaDENS-DT electrostimulator and remote paraorbital electrode DENS-glasses in accordance with the methods presented:

– Patient sit down comfortably, on the paraorbital area a remote elec-

trode DENS-glasses was applied, which was connected with DiaDENS-T apparatus;

- DiaDENS-T was set up in a “therapy” mode at 20 or 60 Hz stimulation frequency at a comfortable application intensity;
- The treatment continued 10-15 minutes during 3 to 5 days a week.

During the treatment it is necessary to make sure that all the electrodes of DENS-glasses tightly abut on the skin in order to prevent apparatus disconnection.

Average duration of the treatment with the help of apparatus made up 8 ± 2 weeks.

The results of the research

9 people out of 10 involved patients finished the treatment, only one patient left the research after the third week of treatment because of personal reasons. We carried out a classical perimetry instead of microperimetry for one of the patients.

No unfavorable results were determined during the control process. Perceptiveness of treatment with the help of DiaDENS-T apparatuses was great.

At the end of every week of treatment patients made a report where they had to include some data about their degree of satisfaction of the accomplished treatment, unpleasant sensations and complications presence.

No one out of 10 patients found the treatment to be burdensome or painful; 8 people stated that they were very pleased with the treatment; 2 people were satisfied with it.

By the end of the treatment 7 patients described the state of an eye comfort, reduction of edema in a paraorbital zone among the experienced sensations.

Patients that suffered from pigmentary retinopathy (C.R., N.D.) and had big eyesight deficiency and tubular field of vision noted that they started to see more light and better distinguish objects and people's features after the treatment.

Patient N.K., that suffered from optical subatrophy as a result of postalcoholic neuropathy noticed, that owing to the treatment he managed to read easier with the help of the support for visually impaired people. We also registered increase of reading speed of this patient.

AV of 4 patients was steady during long period of time without any signs of deterioration when evaluating acuity of vision parameters; no statistically significant changes were registered. 4 patients among the rest noticed a visual acuity improvement; they managed to read 3 letters out of 5 of the same Snellen line, and 2 patients noticed AV improvement of one Snellen line.

Microperimetry allowed us to evaluate DENS treatment efficiency in time taking into consideration, first of all, qualitative and quantitative fixation evolution on the basis of retinal sensitivity.

All the patients who suffered from atrophic and vascular DMS (A.T., R.S., G.F.) demonstrated presence of absolute scotoma in the atrophied retina area or subretinal blood supply at t-0 with unstable peripheral fixation when having microperimetry done. Microperimetry evaluation of these patients on the 1-st, 3-d and 6-th week of treatment demonstrated stabilization of retinal point of fixation (PRL).

Difference between stability of fixation at t-0 and after 6 weeks gave a statistically significant result ($p=0.004$). Density of points of fixation in 2 g. decreased in some cases and stayed permanent in others.

Peripheral fixation of patients who suffered from pigmentary retinopathy with big eyesight deficiency ($<1,30 \log\text{MAR}$) appeared to be unstable during all the time without significant changes before and after 6 weeks of treatment.

One patient who suffered from pigmentary retinopathy (L.G.) did not have a chance to have a microperimetry because a nystagmus was detected, and that hampered the eye movements. In spite of the difficulties caused by nystagmus, an automatic perimetry was carried out for this patient, field of vision was H:30 (Heidelberg) and OCT (Zeiss II) before the treatment and on the 6-th week.

Reduction of depth of scotomas was registered in 2 patients because they perceived the stimulus in stated zones with the reduced intensity. Retinal sensitivity of the rest 8 patients stayed unchanged with the stimulus of the same intensity.

Retinal sensitivity analyses demonstrated that some zones with the atrophy of eye grounds could have certain functionality, and this functionality could grow due to DiaDENS-T apparatus stimulation. Improvement of retinal sensitivity was registered in 2 patients, though this is not a statistically significant result.

Time, that was necessary for examination implementation, was one more parameter that we evaluated when having microperimetry done. All the patients (100 %) showed progressive reduction of time that was necessary for microperimetrical research accomplishment, in average from 15.19 ± 2.25 min at t-0 to 14.25 ± 2.63 min, 13 ± 2.60 min, 11 ± 2.73 min correspondingly after 1, 3 and 6 weeks of treatment.

The difference of average time of examination implementation at t-0 and 6 weeks of treatment is statistically reliable ($p < 0.001$).

Discussion of the research results.

It is important to remember that we involved patients with severe and average degree of a disease, and their eyesight deficiency was at the severe stage of the disease. All the patients that were chosen for our research suffered from retinal pathologies.

It becomes apparent from our research that electrostimulation of the area around the eyes is able to improve PRL stabilization, but does not reliably improve a visual acuity. A significant PRL stabilization is achieved after timely rehabilitation which follows from the purpose of our research.

We can affirm that DENS treatment is able to impact very different pathogenetic mechanisms that underlie degenerative retinopathy and could positively influence them.

The results that were achieved, possibly, could be explained through metabolic processes increase and retinal sensitivity improvement, as it is seen from the results of microperimetry of 2 patients.

As far as transcutaneous electrostimulation, apparently, impacts an optic blood supply and cellular metabolism, such treatment could slow down progression of degenerative diseases that are characterized by metabolic cellular disfunction.

DENS apparatuses could be very important also for glaucomal neuropathy and for EPR-photoreceptors defense when having pigmented retinitis and senile direct degeneration.

DENS effect is high in treatment and prevention of degenerative retinal disorders. Some mechanisms of action could differently affect the reasons of physiopathology of degenerative retinal disorders that we researched.

Electrostimulation of area around the eyes should be considered an efficient therapy not only for rehabilitation of visually impaired people

but also as an auxiliary therapy for prevention and treatment of degenerative retinal pathology.

Practicality of DiaDENS-T apparatus and application convenience of special remote electrodes in a form of glasses make the treatment to be extremely simple and original in comparison with other TENS devices.

Considering the experimental character of the research, we do not yet advise to apply this therapy without the control of ophthalmologist. Though in a future, when enough experience would be accumulated, it would be possible to apply DENS at home.

As a wish. It is necessary to extend our research and increase the number of patients in order to evaluate an efficiency of the therapy also in the environment of visual acuity improvement with all the variants of retinal pathology.

**DENS-THERAPY APPLICATION IN TREATMENT
OF PATIENTS WITH CHRONIC
PERCEPTIVE DEAFNESS**

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Perceptive deafness extension among able-bodied population, high risk of becoming disabled provided that receiving continuous care require new methods of therapy search, that is rather urgent and important medical and social goal. Comparison of dynamic of clinical manifestations in patients with chronic perceptive deafness (CPD) during traditional drug treatment as well as dynamic electroneurostimulation application (DENS) was a purpose of the present research.

Two representative groups of patients were formed for that purpose: basic group consisted out of 32 patients with bilateral CPD in the age range from 42 to 61 years old, and control group included 26 patients with CPD of similar age and sex. All the patients underwent pure threshold and superthreshold tone audiometry as well as subjective tinnitus estimation (ST) by means of standard audiologic methods besides the general examination and auditory analyzer examination.

DENS-therapy was performed with the help of portable apparatus which has transcutaneous, low-frequency, short-impulse, high-amplitude, noninvasive effect on biologically active zones and acupuncture points. By indications patients of the main group underwent DENS course in a constant mode and at a comfortable energy level depending on ST intensity and subject to corresponding diseases along with traditional drug therapy. An application was performed in the zone of frontal complaint projection (ear and parotid zones), central back line and paravertebral lines, in the zone of “cervical annulus” and cervical-collar zone. Average session length was 30 minutes, course treatment duration was 8 to 12 days. Patients of the control group received only traditional drug treatment.

Analyzing the results of the treatment that was performed it is possible to assume that 11 (42.2%) patients of the control group with CPD

demonstrated hearing improvement on 10 dB in average in 250-8000 Hz frequency range; 8 (31%) patients demonstrated abatement of ST or its disappearance. At the same time, positive effect was registered approximately in half of the patients (50.3%) of the basic group with CPD after the DENS course accomplishing combined with drug treatment. For them hearing improvement made up approximately 15-20 dB in the researched frequency range; 19 (59.6%) patients demonstrated abatement of ST or its disappearance.

Thus, combination of DENS with drug treatment for patients with perceptive deafness significantly improves results of complex impact on a patient.

**DYNAMIC ELECTRONEUROSTIMULATION
APPLICATION FOR SURGICAL
AND COLOPROCTOLOGIC PATIENTS DURING
THE POSTOPERATIVE PERIOD**

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Dynamic electroneurostimulation (DENS) has been used since 2002 in Regional clinical hospital of Lipetsk.

Fields of DENS method application in colorectal surgery are the following:

- 1) faster postoperative wounds healing in patients that were operated on acute anal abscess and chronic periproctitis, epithelial coccygeal tract, rectal cancer;
- 2) cutting off postoperative enteroparesis in patients that were operated on the occasion of common forms of peritonitis;
- 3) reduction of pain syndrome and painful phenomena of postoperative period in patients that underwent traditional (opened) interventions concerning colorectal cancer, complicated diverticular disease of colon;
- 4) intensification and fastening of rehabilitation effect that was achieved as a result of laparoscopic operations in patients with colorectal cancer.

Groups of patient, 5-8 persons, which received DENS-therapy in a complex of postoperative treatment were formed according to each stated direction. There were 26 patients observed altogether, where 18 patients were women and 8 patients were men in the age range from 29 to 82 years old.

DENAS or DiaDENS-DT apparatuses were used for DENS application with the help of integrated and trailing electrodes. An action started on the 1-2 day of the postoperative period and ended on 3-4 day. Trocar punctures zones and parapenetrating areas, periumbilical areas crosswise, adrenal glands zones, paravertebral zones, microcorrespondence zones on hands, feet and auricle were processed in “Test” and

“Therapy” mode at comfortable intensity level. Zone selection occurred individually, duration of daily sessions was 20 to 35 minutes.

Pain syndrome of average intensity level significantly reduced after first one-two sessions for all the patients, and was completely eliminated in patients with local coloproctologic pathology; later analgesic prescription, even nonnarcotic analgetics, was not required. Prescription of nonnarcotic analgetics in the 1-4 days after the surgery was required for all patients that did not receive DENS.

Enteroparesis phenomena in coloproctologic patients disappeared after DENS application after laparoscopic operations in average 1.5 days faster than in patients that did not receive apparatus therapy. All the patients that received DENS ambulated and walked in the department on the first-second day of postoperative period. For comparison, patients after standard operations are out of bed on the 4-6 day, walk with assistance on 7-9 day.

Also we registered absence of penetrating wounds complications in patients that underwent DENS course along with more rapid pain relief, paresis elimination, earlier motor activity recovery.

Thus, on the basis of accomplished clinical observations it was revealed that postoperative period of patients with common forms of peritonitis alleviates, rehabilitation potential of laparoscopic operations in colorectal surgery strengthens significantly after the DENS inclusion in complex treatment.

**DENS-THERAPY IN A PROCESS
OF PSYCHOEMOTIONAL STATE CORRECTION
IN WOMEN WITH THE CLINICAL PICTURE
OF SPONTANEOUS TERMINATION
OF PREGNANCY**

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Pregnancy and childbirth is a great emotional factor that significantly influences psychosomatic organization of a woman [1, 2]. It is known, that certain changes of psychoemotional state occur even in healthy women in the time of physiological pregnancy process [2]. Certain psychological disorders appear in healthy pregnant women but they are physiological and provide adaptation of a woman to pregnancy. In case of different complications development, including risk of miscarriage, psychological changes that appear could be referred as pathological because they cause desadaptation development, support and result in pathological processes progressing in the body of pregnant women [1, 4, 5].

In spite of these facts, at present time during examination of patients with miscarriage methods of psychoemotional state evaluation of pregnant women with such pathology as a result of stress and methods of the following adequate impact on such disorders with evaluation of treatment results are not introduced to applied public health.

Pharmacotherapy of miscarriage that is aimed at hormonal disorders correction, inflammatory processes elimination in the system mother – placenta – fetus, causes polypragmasia that is not indifferent to the pregnant woman, fetus and neonate, and not always is effective enough. At present time, there is no enough information for evaluation of adequacy of impact on CNS during application of standard approaches of miscarriage treatment. At the same time, it is known, that CNS is one of the main components of adaptation system.

Given circumstances dictate necessity of development of approaches of examination of patients with miscarriage that are aimed at their psychoemotional state evaluation as an indicator of existing stress level as

well as at adequate, preferably non-drug correction of psychoemotional state of pregnant women, methods usage.

Purpose of our research is to improve an effectiveness of treatment of patients with risk of miscarriage on the basis of psychoemotional state research and its complex correction with the help of transcutaneous dynamic electrostimulation (DENS) application.

Level of health of mother – placenta – fetus system was evaluated in 64 patients with miscarriage during the period from 8 to 22 weeks and in the age range from 17 to 42 years old. There were 38 (59.4%) of primigravidas, 26 (40.6%) women with consecutive pregnancy. 11 (42.9%) patients with repeated pregnancies had labor as a result of previous pregnancies, 13 (50%) had therapeutic abortion and 2 (7.1%) had spontaneous abortion. From the anamnesis it became known that average age of menarche was 12.8 ± 1.2 years old. 34 (53.1%) of pregnant women had extragenital pathologies, and 22 (34.4%) of patients had gynecological disorders.

Miscarriage diagnosis was confirmed with complaints on pain in lower part of the abdomen in 64 (100%) of pregnant and blood-tinged discharge from genital tracts in 17 (26.6%) of pregnant. Uterus tone increase was confirmed with bimanual examination data; uterus hypertone in 23 patients (35.9%) was confirmed with ultrasonic examination, 11 patients (17.2%) had detachment of placenta, retrochorionic hematoma, 4 patients (6.25%) had fetus developmental lagging from gestation periods, 17 patients (26.6%) had reduced caryopyknotic index.

Psychoemotional state was evaluated according to clinical questionnaire [3], which consists out of 68 questions. For each woman the score was determined that characterized her adaptability and stress resistance according to 6 scales: anxiety scale (AS), neurotic depression scale (NDS), scale of asthenia (SA), hysterical reaction type scale (HRTS), obsessive-phobic disorder scale (OPDS), vegetative disorder scale (VDS).

A graph was drawn for diagnostic coefficients results interpretation for each of 6 scales. The state that satisfied an interval of indices from $+1.28$ to -1.28 was considered to be a wellbeing. Index over $+1.28$ indicates high adaptive ability in certain symptom complex; index lower than -1.28 indicates abnormal character of detected disorders (desadaptation state).

DiaDENS-DT apparatus was applied in a “Test” mode at a minimal energy range and in a “Therapy” mode at 77 Hz frequency rate at a

comfortable energy level. An application was carried out in the projection of trigeminal nerve branches output on a face for 2 minutes on each of 6 points. Course made up to 7 procedures.

All the studies of pregnant women were carried out and evaluated in dynamics before and after the treatment course. All the patients under observation were divided into 2 groups. Comparison group that consisted of 34 people received standard therapy (spasmolytics, sedative medications, gestagens, β -mimetics if needed).

DENS-therapy with general course of 5-7 procedures was carried out daily according to described method in the basic group of 30 patients along with standard treatment which was limited only to spasmolytics intake and sometimes gestagens intake.

Analysis of data received during the examination of pregnant women revealed presence of variety stress-factors both psychic and emotional (low and medium intensity) in lives of those patients which permanently affect these women and frequently add one to another. An accomplished research gave an opportunity to understand that the majority of patients insufficiently estimate their condition and do not realize that their psychoemotional stress is increased.

The results of psychoemotional state of patients are given according to different scales.

Anxiety scale (AS). Basic data: 14.7% of patients remained within the norm interval; 47.8% of pregnant women had high adaptive ability (hyperadaptation state); 38.2% of women were not adapted to anxiety (that is they were in anxiety state). After the treatment in comparison group an anxiety state of 50% of patients did not change, anxiety worsened for 16.7 %, adaptation for anxiety increased in 33% of pregnant.

Reduction of adaptive abilities of the body to anxiety was not observed in the basic group. 50% of patients stayed in the same condition, 50% of patients showed significant improvement of adaptation.

Neurotic depression scale (NDS). Basic data: 29.4% of patients remained within the norm interval, 17.6% of patients had neurotic depression, 52.9% of women had hyperadaptation to neurotic depression. After the treatment in a comparison group 75% of pregnant did not show any changes in condition, 4.3% showed worsening of neurotic depression resistance, 20.8% of patients demonstrated increase of adaptation to given parameter. In the basic group 20% of patients did not show any changes in their condition, 50% of patients demonstrated in-

crease of adaptive abilities of the body to neurotic depression, and 30% of women had aggravation of their condition.

Asthenia (SA). Basic data: 23.5% of patients remained within the norm interval, 35.3% of patients were in the asthenic state, 41.2% of patients had an increased adaptation to this parameter. After the treatment course in a comparison group indices were divided in the following way: 58.3% did not have any changes in their condition, 16.7% demonstrated an increase in adaptive abilities of the body, 25% of patients showed worsening of the condition. In the basic group 60% of patients did not have any changes in their condition, 20% of patients showed worsening of reactivity of the body to asthenia, 20% demonstrated an increase in adaptive abilities of the body.

Hysterical reaction type scale (HRTS). Before the treatment 20.6% of patients remained within the norm interval, 29.4% of patients belonged to hysterical type of reaction, 50% of pregnant demonstrated an increased adaptation to this criteria. After the treatment in a comparison group 54.1% did not change their hysterical reaction type, 16.7% demonstrated worsening of the results, 29.2% of patients showed stabilization of indicated parameter. In the basic group 10% of patients demonstrated worsening of their condition, increase of resistance to indicated criteria was observed in 50% of cases, 40% of pregnant did not show any change of condition.

Obsessive-phobic disorder scale (OPDS). Basic data: 20.6% of patients with obsessive-phobic disorders remained within the norm interval, 55.9% of patients had an increased resistance to indicated factor, 23.5% of patients had dysfunctions.

After the standard treatment 16.6% of patients demonstrated worsening of their condition, 66.6% of patients did not show any changes in their condition, 16.8% of patients had their condition improved. 40% of patients did not have any change in their condition or their condition became worse, 20% of patients demonstrated an improvement of their state after complex treatment with the help of DENS was carried out.

Vegetative disorders scale (VDS). Only 8.8% of women under study remained within the norm interval at the time of vegetative disorders research, 50% of patients were in the state of adaptation, 38.2% of pregnant had some dysfunctions. After the treatment course in a comparison group 66.6% of patients had the same indices, 16.7% of patients demonstrated worsening of the state, 16.7% demonstrated improvement of

their condition. 60% of patients did not show any condition change, 40% of pregnant had their indices improved in the basic group after complex treatment with DENS application was carried out. Worsening of the condition was not registered.

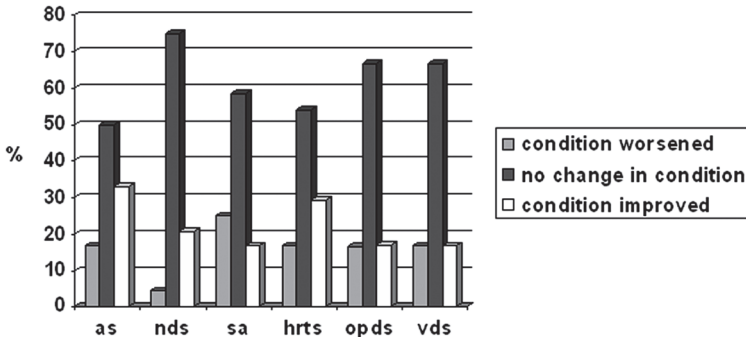


Diagram 1. Dynamic of patients' health after standard treatment (comparison group). Here, AS is anxiety scale, NDS is neurotic depression scale, SA is scale of asthenia, HRTS is hysterical reaction type scale, OPDS is obsessive-phobic disorders scale, VDS is vegetative disorders scale.

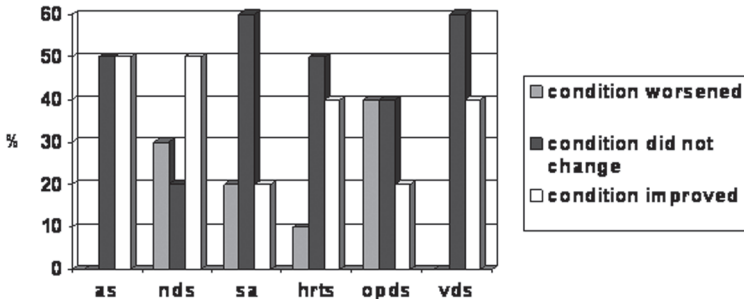


Diagram 2. Dynamic of patients' health after complex treatment with DENS application (basic group). Here, AS is anxiety scale, NDS is neurotic depression scale, SA is scale of asthenia, HRTS is hysterical reaction type scale, OPDS is obsessive-phobic disorders scale, VDS is vegetative disorders scale.

The accomplished research revealed that patients with miscarriages had great number of stress-factors, both acute and chronic. All the factors that had been received were considered according to 3 groups: norm, desadaptation and group with increased adaptive reaction. Sig-

nificant changes in psychoemotional sphere normalization were not registered after the standard treatment, worsening of condition regarding to some scales was observed. DENS-therapy application along with complex treatment caused characteristics improvement in great number of patients.

Thus, the results that were received allow to say that DENS method – non-medicamental correction method – makes it possible to improve psychoemotional status of pregnant women, gives a possibility to prolong pregnancy. According to recommendations of psychologists, data received is required to be analyzed over period of time for therapy consequences to be taken into consideration.

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**RESULTS OF DYNAMIC ELECTRONEUROSTIMULATION
APPLICATION IN EXPERIMENTAL ALLOXAN-INDUCED
DIABETES MELLITUS AND CHRONIC IMMOBILIZED
STRESS ENVIRONMENT FOR RATS**

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Diabetes mellitus is one of the serious medical-social problems of the present. Diabetes mellitus takes third place after cardiovascular and oncological diseases in illness abundance, high rate of mortality of able-bodied population and high percentage of becoming disabled. According to definition of Expert Committee of WHO, diabetes mellitus is "...a state of chronic hyperglycemia which could develop due to numerous exogenous and genetic factors impact". Multicomponent theory of diabetes mellitus etiology and pathogenesis, that takes into consideration genetic, immunological, infectious, dietary, dyshormonal and stress factors, is the most developed one at present time. Pathogenesis of insulin-dependent diabetes mellitus (type I) is caused by death of b-cells that are found in pancreas and secret insulin, which results in absolute insulin deficiency. Pathogenesis of insulin-dependent diabetes mellitus (type II) is caused by tissues' receptors insensibility to insulin as well as with disorder of b-cells insulin secretion.

The research of dynamic electroneurostimulation (DENS) impact on glucose blood content when having alloxan-induced diabetes mellitus in stress-unstable rats in chronic immobilized stress environment was a purpose of present research.

Materials and methods of the research

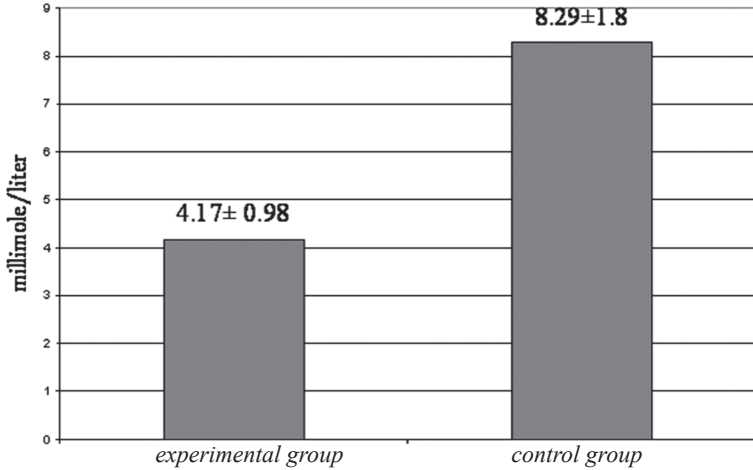
Experiments were held on sexually mature outbred male rats which were preliminary tested, according to "open field" method, on emotional stress resistance [2]. Passive animals that could be predisposed to stress were chosen for the experiment. Experimental diabetes mellitus was brought on by means of single intraperitoneal introduction of

diabetogenic dose of alloxan – 17 mg on 100 g of body weight. Alloxan (meoxamile-urea) has cytotoxic effect, damages beta-cell of pancreatic islets (islet of Langerhans), models type I diabetes mellitus. Emotionogenic immobilized stress was created by two-hour rigid fixation of animals to research-oriented machine belly up. Rats were divided into two groups before the beginning of experiment: experimental and control ones – 10 animals in each group. All the animals remained in immobilized stress environment. Experimental group received DENS. Dynamic electrostimulation was accomplished by means of DiDENS-DT apparatus (manufacturer Co Ltd “RZ ART”, Yekaterinburg, Russia); electrodes of the apparatus were applied to the tail of the rat on 10 minutes during its immobilization period. Experiment was held daily during 14 days. Glucose and corticosteroid (11-OCS) amount was detected in the blood of animals after the end of experiments. Keeping, care of animals, leading out of experiment proceeded in accordance with “Rules of works execution when using laboratory animals” (Attachment to the Order of MH USSR from 12.08.1977, № 755). Statistical processing was carried out with the help of software package named “Statistics” using Student’s test.

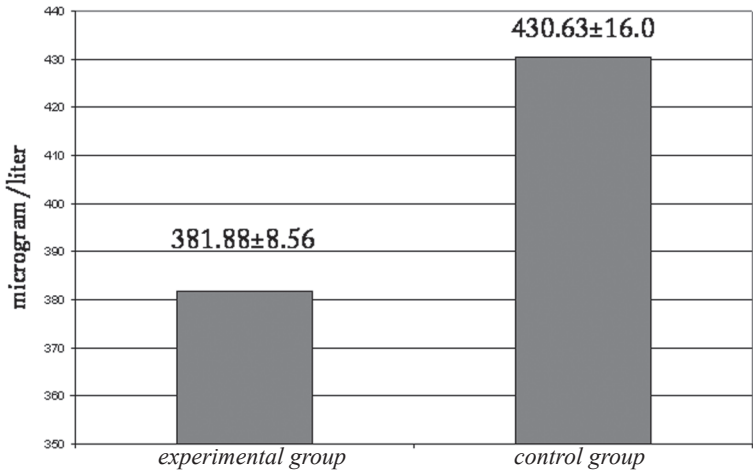
The results received and their discussion

After single introduction of diabetogenic dose of alloxan glucose blood content of stress-unstable experimental animals of control group, that were kept for two weeks in immobilized stress environment, constituted in average 8.29 ± 1.8 millimole/liter, 11-OCS content was 430.63 ± 16.00 microgram/liter (picture 1). Group of animals that daily received 10-minutes DENS during all the period of experimente (experimental group) demonstrated 4.17 ± 0.98 millimole/liter blood glucose content, which was reliably lower than in a control group ($P < 0.05$). 11-OCS level in experimental group was lower than in control group as well and constituted 381.88 ± 8.56 microgram/liter (picture 2).

Thus, basing on the data received it is possible to conclude that dynamic electrostimulation in experimental alloxan-induced diabetes mellitus environment, when having chronic immobilized stress, prevents hyperglycemia development in stress-unstable animals and insignificantly reduces corticosteroids blood level of these animals.



Picture 1. Blood glucose level of animals of experimental and control groups after single introduction of diabetogenic dose of alloxan.



Picture 2. 11-OCS blood level of animals of experimental and control groups after single introduction of diabetogenic dose of alloxan.

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**THE AURICULAR DENS-PUNCTURE
PHYSIOLOGICAL EFFECTS STUDY**

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Introduction of DiaDENS line electrostimulators with remote point electrode to medical practice opens up new possibilities of DENS-puncture application for medical purposes. It is known, that auricular electropuncture has some advantages over impact on some other points. First of all, this is due to high efficiency and responsiveness to the impact. This is conditioned by great innervation of an auricle and its powerful neuro-reflex connections with the structures of the brain stem [3]. The other advantage of auricular electropuncture is the possibility of sufficiently accurate determination of arrangement of points for impact and periodical control of results of treatment with the help of auricular diagnostics, which got new possibilities after “BIOREPAIR” technology development [6].

Selection of impulse sequence frequency is important at the time of determination of parameters of electropuncture impact with electrostimulators of alternating current assistance. However, currently there is no common opinion on this question due to small number of special researches devoted to auricular points stimulation optimization when treating different pathological manifestations. For instance, in some reflex therapy guidance an effect on auricular, as well as on corporeal points with low frequency current (1 to 10 Hz) is recommended; it is recommended to use stimulation frequencies that correspond to electroencephalogram alpha-rhythm of human being (8-12 Hz) when treating functional disorders of CNS (neurasthenia); herewith, all auricular points that are included in a “formula” are stimulated with equal frequency [5]. Meanwhile, European school of auricular medicine founder P. Nogier [7] basing on the data received from carried researches suggested to utilize different frequencies for stimulation of different anatomical zones of auricle:

- Internal part of hircus and interhircus notch – 2.28 Hz;
- cavity of concha – 4.56 Hz;

- upper part of helix and upper crura of antihelix – 125 Hz;
- posterior part of helix from Darwinian tubercle to posterior auricular sulcus – 18.25 Hz;
- peripheral part of helix – 36.5 Hz;
- posterior part of earlap – 7.3 Hz;
- anterior part of earlap – 146 Hz.

However, impact evaluation method (by pulse wave change) that was used by P. Nogier is not accurate enough and is only a qualitative method. Besides, impact on the same point by different frequencies quite often causes multidirectional effect on radial artery pulsation; at the same time, absence of pulsation change is not an evidence of absence of effect from auricular point impact. At the time of auricular points impact genetic reactions are realized through changes of functional activity of CNS structures which, in turn, change an activity of sympathetic and parasympathetic parts of vegetative nervous system (VNS) [3]. This, in turn, causes change of radial artery pulsation and other effects. Application of more accurate and up-to-date research methods (for example, functional activity of VNS) is necessary for more precise evaluation of results of auricular points stimulation by different frequencies. It is rational to use an analysis of VNS condition as such method applying registration of heart rate variability (VHR). This research method demonstrated high self-descriptiveness when analyzing functional state of the body both in normal condition and in different unhealthy conditions that cause neuro-vegetative regulation disorder [1, 8].

Study of impact of different frequencies electrostimulation of auricular points on functional activity of VNS is a purpose of present work. In order to achieve this goal we were solving the following problems:

1. Evaluation of 200, 77, 77/10, 10, 5, 4 Hz frequencies impact on functional activity of VNS;
2. Effects of impact by different frequencies on points of different anatomical regions and points of same anatomical area comparison;
3. Minimal effective duration of impact determination when stimulating auricular points by different frequencies.

Materials and methods of the research

36 almost healthy volunteers under test and 18 people suffering from overweight and obesity of 1-2 stages participated in the research. 4 to 20 researches were made with each of subject of the experiment, and

electrostimulation of auricular points by different frequencies was carried out in different days in order to eliminate a summation effect.

VHR registration was accomplished with the help of «Orto-Science» and «Orto-expert» (Russia) development package in the background, during auricular points electrostimulation and 1 – 30 minutes after stimulation was over. Indices during and after stimulation were analyzed with the help of «Orto-expert» program that included evaluation of heart rate indices (mode, mode amplitude, tension index (TI), heart rate, indices of spectral analyses of heart rate) in a sitting position and after rising to feet. Comparison of indices in a sitting position and after rising to feet allowed to evaluate a vegetative reactivity and vegetative activity support.

Points of different anatomical zones were used for study of different frequencies' effects of auricular electrostimulation: points of upper and lower bowl, upper crura of antihelix, triangular fossa, tragus and earlap. Electrostimulation of stated points was carried out by means of remote coaxial point electrode during 2 minutes at the comfortable energy level. For continuous registration of heart rate parameters «Orto-Science» complex program was used at the time of necessary impact duration determination in order to get a functional activity of VNS change effect. An impact on auricular points was carried out during 1 to 5 minutes at a comfortable energy level.

The results of the research and their discussion

200 Hz frequency action evaluation was carried out in a group of 22 people. An impact was made on the points of different anatomical regions. In the zone of lower bowl an application was carried out on auricular points (AP) 100 (heart) or 101 (lungs), in the zone of earlap at AP10 (tonsils), in the zone of upper bowl AP92 (urinary bladder), in the zone of earlap at AP10 (tonsils) and AP8 (eye). Electrostimulation was carried out during 2 minutes. Stimulation of only one point was accomplished at the day of the study. An effect of outcome was evaluated within 30 minutes. Reliable changes of vegetative regulation state, vegetative reactivity and vegetative activity support were not registered integrally in the group. Also no reliable difference in indices was received when stimulating points of different zones.

77 Hz frequency action study was carried out in a group of 25 people. An application was made on the same points as with DENS-punc-

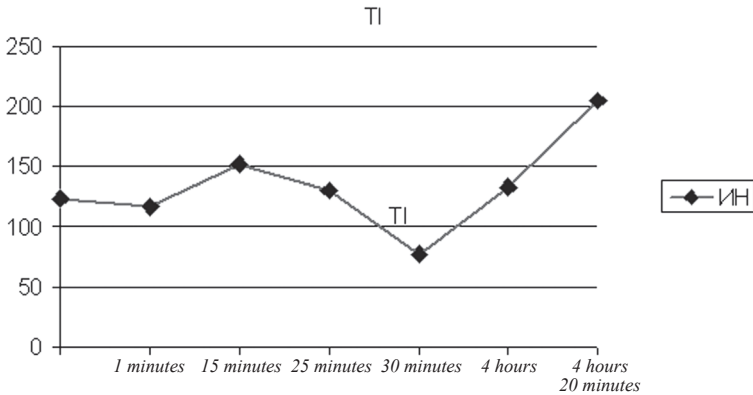
ture at frequency 200 Hz. Data received is an evidence of the fact that 77 Hz frequency has a pronounced sympathotonic effect when affecting points of upper and lower bowl (AP 100, 101, 103, 92, 88, 91), as well as earlap points (AP 10, 8) and points of triangular fossa (AP 55, 58). When registering heart rate variability this effect becomes apparent in heart rate (HR) increase, mode amplitude increase (moA) and increase of heart rate tension index (TI). L/H index increase (ratio of power of slow and fast rates), which is also an evidence of sympathetic activation, and power increase of superslow spectrum component VLF, which is an evidence increase of humoral contribution to VNS activity regulation, were detected during spectral characteristics analyses. This corresponds with data of previously carried researches of DENS effect at 77 Hz frequency on the cervical collar zone and the zone of segmental innervation of internal organs. A pronounced anti-inflammatory, antioxidant, anaesthetic and other effects were demonstrated in these researches, which allows to consider DENS with stated frequency to be an activation therapy alternative [2]. The results that were received are an evidence of the fact that 77 Hz frequency except for a local action has an activation therapy effect which does not depend on an area of stimulation application and, apparently, is determined by impact on CNS brain stem structures.

On the contrary, application of 10 Hz frequency for the same points stimulation causes parasympathetic effect, which is expressed in heart rate decrease, moA and TI lowering, and high-frequency (Hf) component increase during spectral analysis of undulatory structure of a heart rate. However, some points have certain specific of such effect realization. So, when having 10 Hz frequency stimulation of AP100 (heart) parasympathotonic effect is mainly realized at the expense of nervous mechanisms, when having AP10 (tonsils) stimulation, this effect is chiefly realized at the expense of humoral mechanisms activation. Similar but more pronounced effect was received when stimulating auricular points at 77/10 frequency. When having DENS-puncture with stated frequency application heart rate, TI, moA decrease was observed as well, and that is an evidence of sympathetic tone of VNS lowering, RMSSD-index increase, which is associated with parasympathetic impact activation. Unlike 10 Hz frequency, DENS-puncture at 77/10 frequency causes an evident ($P < 0,01$) increase of TF index – total spectrum power of heart rate undulatory structure. From physiological point

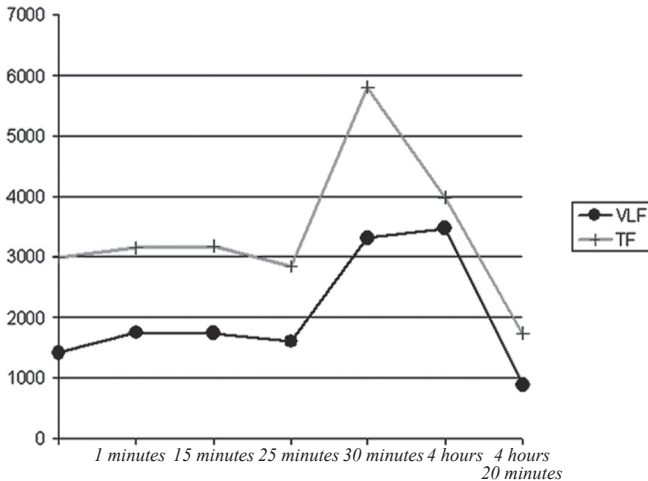
of view these data could be interpreted as lowering of heart rate management centralization, which corresponds with lowering of neuropsychic stress and increase of adaptation level. Similar psychotropic effect of stated mode was described for cervical collar zone stimulation [4].

More complicated and ambiguous effects were registered when studying low frequencies of 4-5 Hz. In this case, physiological effect and vegetative regulation change orientation depended on the point of stimulation and electroanomaly of the point existence (and consequently, possible pathology of the corresponding organ). Reliable changes of vegetative regulation were not determined during AP49 point (knee) application in the area of upper crura of antihelix; parasympathetic effect was received during AP87 (stomach) point application; impact on AP100 (heart) caused multidirectional effects in people with dominant initial sympathetic and parasympathetic tone of VNS. At the same time, stimulation of this point with the 4-5 Hz frequency caused lowering of TF index in all the people under study (total power of wavelength spectrum), and that is an evidence of regulation centralization increase and adaptation level lowering, that is these frequencies are unfavorable for an impact on this certain point. An interesting data was received when stimulating AP18 (hunger) point at 4 Hz frequency. This point is used for appetite lowering and reduction of pathological attraction to food when treating overweight and obesity. The following data was received after stimulation of this point at 4 Hz frequency during 2 minutes in 18 people under study (pictures 1, 2). At the background before the stimulation all the subjects of an experiment felt hunger because followed the low-calorie diet, also they had their last food intake about 2-3 hours ago. Vegetative regulation indices indicated moderate increase of neuropsychic stress (TI about 130 standard units) and VNS activity shift towards sympathytonia (L/H is more than 5 standard units). At the beginning right after stimulation a pronounced sympathetic effect (moA, TI, L/F increase, RMSSD decrease) is registered after DENS-puncture of AP18 during 2 minutes at the threshold of feeling frequency. And activation of both nervous and humoral components of sympathetic activation is happening. It is possible to make such a conclusion due to VLF index increase – power of superslow waves of HRV spectrum. On the opposite, 15 minutes after the stimulation an increase of parasympathetic system activity, psycho-emotional stress reduction and adaptation level increase is registered. This tendency reaches its maximum 30 minutes

after the stimulation. Particularly at this time the majority of subjects of an experiment felt feeling of hunger weakening, anxiety and annoyance reduction. An effect was seen during 3-4 hours after stimulation was over. After that, a slow return to the initial level of indices of vegetative regulation and psycho-emotional state occurred.

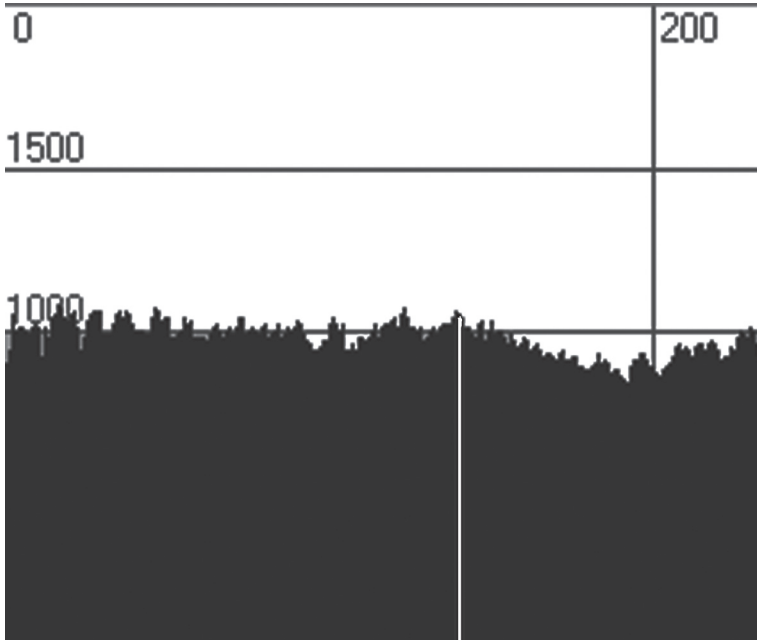


Picture 1. TI dynamics after AP18 stimulation. X-axis is time after AP18 stimulation cessation, Y-axis is TI value in standard units.



Picture 2. Dynamics of superslow component (VLF) and total power (TF) of VHR spectrum after AP18 stimulation. X-axis is time after AP18 stimulation cessation, Y-axis is power of spectrum value in standard units.

Application of VHR for evaluation of DENS-puncture effects on auricular points allowed to solve the problem of minimal necessary duration of application with different frequencies and duration of stimulation effect maintenance. Moment of change of rate character and its undulatory structure (acceleration or deceleration of pulse rate, appearance or disappearance of waves in a spectral structure, etc.) was traced in the continuous operation of stimulation with the help of «Orto-Science» program. Picture 3 demonstrates an effect of AP18 stimulation at 4 Hz frequency.



Picture 3. Heart rate acceleration and undulatory structure change on the 141-st second of stimulation. The beginning of rate indices change on the 141-st second is marked by white line.

Using this approach, we analyzed necessary time of application for different points and frequencies. It was determined that higher DENS-puncture frequency is faster the primary effect of stimulation would come. For 77 Hz frequency this time made up 18 to 45 seconds for dif-

ferent people under study, for 10 Hz frequency – from 34 to 89 seconds, for 4 Hz frequency – from 58 to 156 seconds. A positive correlation between minimal necessary duration of stimulation and electroanomaly of the point was discovered as well. Electroanomaly was evaluated by means of “BIOREPAIR” auricular diagnostics method. Results that were received could be explained through intensification of reflex connections of auricle points, that correspond with projections of the organs with dysfunctions, with CNS structures through which a medical effect of auricular therapy is mediated.

Conclusions:

1. Different DENS-puncture frequencies has different impact on VNS tone.
2. Orientation of action on VNS tone does not depend on the point of application for some frequencies (for example, 77 Hz and 77/10 Hz).
3. 10 Hz frequency when effecting all the tested points has similar parasympathetic effect, however, humoral contribution is expressed more or less depending on the point of stimulation.
4. 4 and 5 Hz frequencies could cause multidirectional effects of vegetative regulation change when effecting different points.
5. Higher frequencies of electrostimulation cause more rapid effect of vegetative tone change.
6. Speed of stimulation effect approach positively correlates with the level of electroanomaly of the point.

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