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## IX. ABSTRACTS

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### I. PREFACE

### II. APPLICATION OF TRANSCRANIAL ELECTRIC STIMULATION IN NEUROLOGY

#### 1. Use of Transcranial Electric Stimulation and $\alpha$ -stimulating Training in Treatment of Patients with Central Postapoplectic Pain Syndromes

*Chernikova L. A., Sashina M. B., Kornyxkhina E. Yu., Shestakova M. V.*

There was shown that combined therapy, that includes standard approved medicines together with rehabilitation methods (transcranial electric stimulation and  $\alpha$ -stimulating training) were more effective in therapy of central postapoplectic pain syndrome as compared with using medicines alone. Therapeutic effects of combined use of transcranial electric stimulation and  $\alpha$ -stimulating training have specific features depending on the location of the pathologic site as well as severity of affective disturbances. In case the focus was located in thalamus or in the left hemisphere and thalamus there should be preferred to apply transcranial electric stimulation together with basic medication, as it was substantially decreasing the intensity of hyperpathia and hyperkinesia. If patient had affective disorders then treatment of choice should be containing  $\alpha$ -stimulating training that profoundly influences on affective pain component as well as severity of astheno-depressive disorders. Prospective follow-up analysis found that 6 months after completing therapy the most stable clinical effect was observed in patients that were given transcranial electric stimulation or  $\alpha$ -stimulating training together with basic medication. Thus, by including rehabilitation methods into the treatment program for patients with central postapoplectic pain syndrome increased therapeutic effectiveness will be definitely achieved that eventually gives rise to more steady curative effect.

#### 2. Impact of Transcranial Electric Stimulation on Emotional and Conative Disorders as Well as Cognitive Impairment in Patients with Parkinson's Disease

*Kornyxkhina E. Yu., Chernikova L. A., Ivanova-Smolenskaya I. A.,  
Karabanov A. V., Fedin P. A.*

We examined patients with Parkinson's disease (PD), moderate degree, with trembling-rigid, rigid-trembling, and akineticorigid forms. Patients of

both test (TES-therapy) and control (placebo) groups were treated with basal antiparkinsonian medicines (Madopar, Mirapex, Midantanum). Antidepressants and anti-anxiety medicines were not prescribed. There was found that basal motor symptoms were decreased in 70.3% patients of test group, whereas only 30% patients of control group had them. Moreover, level of decline was substantially bigger in the former vs. the latter group. In addition, patients of test group had significantly diminished level of emotional and conative disorders. General level of cognitive functions increased in test group by 5.2% ( $p < 0.05$ ), with no clear-cut changes in control group. Also, 77.7% patients of test group were found to have improved attention concentration as compared with controls. Depression was decreased by 68.7% in test group, whereas in control group – only by 23.6%; anxiety level decreased by 53.1% and 26.1%, respectively. Thus, addition of transcranial electric stimulation to the complex therapy of patients with PD is considered to be worthwhile, as it leads to decreased intensity of depressive, anxiety and cognitive disorders. This method has few contra-indications, safe and easy-to-use.

### **3. Fluvoxaminc, Amitriptyline and Transcranial Electric Stimulation of the Brain in the Treatment of Chronic Daily Headache**

*Tarasova S. V., Amelin A. V., Skoromets A. A.*

Efficacy of antidepressants fluvoxamine, amitriptyline and transcranial electric stimulation of the brain in the treatment of chronic daily headache has been studied. Amitriptyline had the highest effect in dosage 50 mg daily but was not well tolerated by patients that resulted in that only 50% of them finished the study. Fluvoxamine had high efficacy and good tolerability in the treatment of chronic daily headache and medication overuse headache. Small dosages of amitriptyline and fluvoxamine potentiated the analgesic effect of transcranial electric stimulation of the brain. The combination of antidepressants with transcranial electric stimulation of the brain alleviated the negative effect of the withdrawal of overused analgesics and may be recommended for out-patient use.

### **4. Effectiveness of Manual Therapy used Together with TES-procedures in Patients with Néri-Barré-Liéou Syndrome**

*Gorokhov B. N., Gorokhov S. B., Enatstki S. Yu., Yurov A. F.*

Therapeutic effectiveness of patients with confirmed Néri-Barré-Liéou syndrome was estimated by comparing manual therapy alone or together with TES-procedures. By using combined therapy curative effect was developing 1.5–2 fold faster.

## **5. Transcranial Electric Stimulation as an Approach to Potentiate Anti-nociceptive Effect Elicited by Sanatorium-resort Therapy in Patients with Cervical Dorsopathy**

*Kazakova M.S., Karakulova Yu.V.*

Transcranial electric stimulation (TES-therapy) potentiates effect of curative balneal and bog factors found at the resort “Klyuchi”, and facilitates achievement of far better therapeutic effectiveness within shorter period of time. There was found that 2 week courses of balneal and bog therapy combined with TES-therapy were as effective as 3 week course of basic therapy. Moreover, such shortened courses were more affordable to patients as well as sanatorium-resort compounds due to obviously reduced stay in the resort.

## **6. Effectiveness of Brain Transcranial Electric Stimulation in Correction of Pain Syndromes and Psycho-vegetative Status During Treatment of Patients with Lumbar Dorsopathy**

*Panasyyuk I.Ya., Shutov A.A., Karakulova Yu.V.*

Addition of TES-therapy as a part of complex therapy in patients with vertebragenous chronic low back pain potentiates therapeutic effect of curative balneal and bog factors provided at the resort “Klyuchi”. Altogether, it facilitates achievement of more advanced therapeutic effectiveness – significant decrease of pain intensity, reduction of anxiety and depression, magnitude of vegetative disorders, substantially improving parameters of patients’ life quality. By including shortened balneal and bog therapy combined with TES-therapy for treatment of such patients they were found to be more superior in terms of direct clinical effectiveness as compared with basic therapy courses. The results of combined therapy validate a reason to include it as routine service at balneal and bog resorts.

## **7. Immediate Influence of Transcranial Electric Stimulation on Pain and $\beta$ -endorphin Blood Levels. An Active Placebo-controlled Study**

*Gabis L., Shklar B., Geva D.*

Methods: We conducted a randomized, double-blind, placebo-controlled study on 20 chronic back pain patients. They were treated with either transcranial electric stimulation (TES) or an active placebo device. Pain level and serum  $\beta$ -endorphin levels were measured before and after treatment. Results:  $\beta$ -Endorphin level increased in seven of the ten patients from the treatment group and did not change in eight of ten patients from control group ( $P = 0.057$  between groups). Pain level decreased in eight treated patients and seven control patients (significant decrease for each group, no

significant difference between groups). Conclusions: transcranial electric stimulation is a nonpharmacologic method of pain relief accompanied or mediated by  $\beta$ -endorphin release. The comparable degree of the initial clinical response emphasizes the powerful placebo effect on reported pain not mediated by endorphin release. This preliminary study shows that noninvasive electrical stimulation is a safe treatment with a positive effect on  $\beta$ -endorphin blood levels.

## **8. Complex Rehabilitation of Emotional-affective Disorders by Applying Transcranial Electric Stimulation and Binaural Rhythms**

*Urzaeva F. H., Urzaev K. F.*

In this study we were interested in checking if it is possible to use a complex approach that involves transcranial electric stimulation and binaural rhythms to perform psychocorrection of emotional-affective disorders. There was found that such complex therapy is effective in reducing frequency of depressive states, anxiety, computer addiction, excessive gambling, and age-related deviations of mental development. Curative effect was accompanied not only with improved clinical picture and psycho-physiologic parameters of these patients, but also with remarked positive effect on mental health. Anxiety level was profoundly reduced (Spielberger-Hanin and Taylor tests), subjective test on sense of health, activity and mood were improved (by SAM questioner: state of health-activity-mood).

### **III. APPLICATION OF TRANSCRANIAL ELECTRIC STIMULATION IN GASTROENTEROLOGY**

#### **9. Application of Transcranial Electric Stimulation (TES-therapy) in Therapy of Gastroesophageal Reflux Disease**

*Berest D. G., Shiman A. G., Tkachenko E. I., Lebedev V. P.*

By using TES-therapy as a part of combined therapy of patients with gastroesophageal reflux disease it was found to have a profound analgesic and vegetative correcting effects, which are seen as effective pain relief, boosted reparation of erosive processes, and improved patients' of quality life. TES-therapy moderately influenced esophageal acidity level. In addition, it was enhancing esophageal motility having anti-reflux effect.

#### **10. Use of Transcranial Electrostimulation in Treatment of Laryngopathy Caused by Gastroesophageal Reflux Disease**

*Kokorina V. E.*

Clinical picture of laryngopathy caused by gastroesophageal reflux disease mostly is due to disorders of upper esophageal sphincter associated with

transient episodes of relaxation of lower esophageal sphincter. Transcranial electrostimulation of brain defense mechanisms (TES-therapy) normalizes tonic activity of upper esophageal sphincter and decreases gastric secretory activity, thus, directly acting on the cause of disorder developed in the larynx and trachea. Moreover, TES-therapy immediately induces healing of lesions in the laryngeal mucosa. The most prominent clinical effectiveness was found when TES-therapy was combined with proton pump inhibitors.

### **11. Impact of TES-therapy on Clinical Picture and Laboratory Tests under Gastroduodenal Ulcers**

*Kasatkin S. N., Panov A. A., Kasatkina S. G.*

TES-therapy as a part of complex therapy of gastroduodenal ulcers allows to remarkably accelerate patient's recover from main symptoms by 4-5 days, that, in turn, decreases duration of stay at hospital. There was shown that TES-therapy stimulates reparative processes, and normalizes levels of Lactoferrin and tumor necrosis factor. In addition, TES-therapy contributes to decrease of antibodies against *Helicobacter pylori* that depend on form of disease, location of ulcerous lesion, and patient's age. It correlates with positive effect of TES-therapy on clinical symptoms, laboratory tests, which estimate activity of inflammatory process and enhanced reparation of ulcerous defects.

### **12. Influence of Gastroduodenal Pathology and its Treatment on Quality of Life in Children**

*Rychkova S. V.*

Current study is a continuation of longstanding investigation on evaluation of TES-therapy effectiveness under treatment of gastroduodenal pathologies. There was found that, aside from curative effects that may be revealed under physical examination, this method facilitates to substantial improvement quality of life in youngsters with gastroduodenal pathologies. It was proved to stay not only during treatment, but also at long-lasting remission. In addition, benefits of using TES-therapy as compared with standard medication are described.

### **13. Use of TES-therapy as a Means of Non-pharmacologic Correction of the Main Symptoms of Irritable Bowel Syndrome**

*Tkachenko E. I., Lebedev V. P., Mirgorodskaya E. V.*

We were able to show that TES-therapy in patients with Irritable Bowel Syndrome (IBS) was decreasing frequency and intensity of pain syndrome. Moreover, in case of obstipational and diarrheal forms weekly defecation rate was close to normal rate. Interestingly, impaired intestinal motility was

corrected under all IBS forms (according to electrogastrointestinography), especially in patients with diarrheal form. Independently on IBS form TES-therapy was found to improve quality of life on all scales that characterize physical, psychological and social activity of patients. The most substantial, depression and anxiety level were reduced in patients with constipation and diarrhea, who had originally more profound clinical symptoms.

#### **14. Regarding to Application of Transcranial Electric Stimulation in Treatment of Patients with Irritable Bowel Syndrome (Clinical Trial Report)**

*Ruchkina I. N., Parfenov A. I.*

Positive clinical dynamics was observed in patients with Irritable Bowel Syndrome (diarrheal form), after TES-therapy course. First of all, it was seen in terms of pain management and improved patients' overall condition. Thus, TES-therapy may be included into complex therapy of patients with IBS as a non-pharmacological method to act on its pathogenetic stages.

#### **15. Experimental Therapy of Alcohol Liver Cirrhosis by Using Transcranial Electric Stimulation of the Brain Endorphinergic Structures**

*Lebedev V. P., Melikhova M. V., Kolbasov S. E., Stroykova G. S.*

There was found that during experimental alcoholic liver cirrhosis in rats application of transcranial electric stimulation had a normalizing effect on parameters of liver pathology – cytolytic syndrome (including measurement of membrane-bound hepatocyte enzymes), lipid peroxidation level and activity of antioxidant system, as well as absence of excessive growth of intra- and paralobular connective tissue. All this suggests that TES-therapy has a clear-cut curative effect. It allows us to propose TES-therapy for use in clinical practice for treatment of chronic diffuse liver diseases.

#### **16. Stimulatory Effect of $\beta$ -endorphin on Liver Tissue in Organotypic Culture**

*Chalisova N. I., Lesnyak V. V., Lebedev V. P.*

There was found that even a short-term incubation with  $\beta$ -endorphin at micromolar concentration is able to stimulate proliferation and migration of cells in organotypic culture of liver tissue. This effect was dosage-dependent, with bell-shape “dosage-effect” dependency, typical to  $\beta$ -endorphin. The data obtained from in vitro experiments let us to assume that hepatopropic effects from TES-therapy could be in vivo mediated by direct action of  $\beta$ -endorphin on liver tissue.

## **17. Use of TES-therapy in Treatment of Chronic Diffuse Liver Diseases**

*Emelyanov D. N., Tumarenko A. V.*

Monotherapy with transcranial electric stimulation (TES-therapy) in patients with chronic diffuse liver diseases was found to have multi-faceted positive effect on liver hemodynamics, systemic microcirculation, severity of cytolytic syndrome, lipid peroxidation and antioxidant system. TES-therapy was shown to be effective, convenient in use, affordable, and had few contraindications.

## **18. Activation of Reparative Regeneration and Insulin-producing Function of Pancreatic $\beta$ -cells by Transcranial Electric Stimulation in Rats with Alloxan-induced Diabetes**

*Lebedev V. P., Bilichenko S. V., Ordyan N. E., Pivina S. G.,  
Nechiporenko S. P., Puzyrev A. A., Mikheeva E. A.*

In rats with alloxan-induced diabetes there was found that transcranial electric stimulation of brain endorphinergic structures stimulates regeneration of  $\beta$ -cells in pancreatic Langerhans islets. Such effect was confirmed on pancreatic material, stained with Haematoxylin-Eosin. Moreover, development of new pancreatic islets was revealed suggesting that they originated from progenitor cells. After transcranial electric stimulation  $\beta$ -cells in pancreatic islets were found to restore cellular granularity which is a sign of insulin production (Gomori stain). In addition, in accordance with these data there was found that blood insulin levels were restored (by ELISA), which were in significant inverse correlation with decreased blood glucose levels. Thus, anti-hyperglycemic effect induced by transcranial electric stimulation in rats with alloxan-induced diabetes is mediated by reparative regeneration  $\beta$ -cells in pancreatic Langerhans islets accompanied with restoration of insulin producing function.

## **19. Effectiveness of Transcranial Electric Stimulation (TES-therapy) of the Brain Endorphinergic Structures in Correction of Disorders of Carbohydrate Metabolism in Patients with Type 2 Diabetes Mellitus**

*Rogova N. V., Petrov V. I.*

In our study we evaluated effectiveness of TES-therapy introduced into complex therapy of type 2 diabetes mellitus (DMT2) in patients without obesity (PwO) and with obesity (PO). For this we were measuring glycemia and insulin production. TES-therapy was found to be highly effective in PwO group, where functional activity of pancreatic  $\beta$ -cells was reduced. Therapeutic effect from applied TES-therapy was superior to Glibenclamid, especially in terms of normalization of insulin secretion stages, lack of hy-

poglycemic states. Despite a marked hyperinsulinemia and insulin resistance in PO group TES-therapy did not elicit increase of hyperinsulinemia, but reduced postprandial glycemia suggesting that TES-therapy might have been able to reduce insulin resistance. Overall effect from TES-therapy alone was less pronounced as compared with Siophor treatment. However, when TES-therapy was combined with Siophor it completely compensated disorders of carbohydrate metabolism in patients with DMT2 having obesity. The data obtained suggest that TES-therapy being used in complex treatment of patients with DMT2 has promising perspectives for a wider use in clinical practice.

#### **IV. APPLICATION OF TRANSCRANIAL ELECTRIC STIMULATION IN OBSTETRICS AND GYNECOLOGY**

##### **20. Transcranial Electric Stimulation in Clinical Practice in Women with Premenstrual Syndrome**

*Aganezova N. V., Vovk A. V., Slivankova E. V., Linde V. A., Shabalina A. Yu., Krinicya E. Ya.*

We examined 20 women with different forms of premenstrual syndrome (PMS) – neuro-psychological, crisis-cephalgic (autonomic-vascular), metabolic-endocrine, trophic and mixed. PMS forms were confirmed by evaluation of dominant symptoms typical for each of them. Only patients with mild and moderate forms were included in our TES monotherapy study, as severe forms usually need to apply complex therapy. There was found that in case of crisis-cephalgic form TES-therapy was diminishing intensity of clinical picture by 63.7%. Level of psycho-emotional symptoms was decreased by 71.7%. In case of trophic form positive dynamics was seen as amelioration of acne and change of appetite. However, joint pains remained unchanged. No complications or side effects were documented after use of TES-therapy.

##### **21. Transcranial Electric Stimulation in Treatment of Premenstrual Syndrome**

*Rybak V. A., Kurushina O. V.*

Here we report that TES-therapy combined with other methods was highly effective in correction of symptoms of premenstrual syndrome. The regimen for transcranial electric stimulation was consisted of 10 daily procedures (starting from day 10 of menstrual cycle) followed by use of tricyclic antidepressant Coaxil (Tianeptine) for 1.5 months. We found that after complex therapy positive dynamics in clinical picture was seen in 81% women, in particular, by arresting pain feelings, normalization of vegetative and psycho-emotional state.

## **22. Transcranial Electric Stimulation in Complex Therapy of Pregnant Women with Gestosis**

*Zharkin N. A., Miroshnikov A. E.*

To estimate effectiveness of treatment of pregnant women with mild and moderate gestosis at 3<sup>rd</sup> trimester, we were daily monitoring their blood pressure and increment of edema. Examined patients were divided into two groups – treated with standard pharmacological medicines (control group) and complex therapy (test group), that included standard pharmacological medicines together with transcranial electric stimulation (TES-therapy). In control group satisfactory clinical effect was obtained in 61.3% pregnant women, whereas in test group – in 80.8%. Interestingly, anti-hypertensive effect in test group was lasting longer independently on taking anti-hypertensive drugs, whereas in control group it was reached only under continuous medication taking. Generally, complex therapy in test group allowed to carry pregnancy till physiological term in 77% women as compared with 59.7% in controls. The Apgar score for newborns in test group assessed at first minute was  $7.3 \pm 0.35$  scores, at 5 minutes –  $7.8 \pm 0.4$  scores, which is significantly different from those found in controls ( $p < 0.05$ ). Overall results of treatment after using transcranial electric stimulation were subjectively and objectively more pronounced in contrast to the standard pharmacological therapy.

## **23. TES-therapy in Treatment of Late Miscarriage**

*Vusik I. F., Ermoshenko B. G., Kade A. Kh.*

In our study we examined women with potential miscarriage who had previous premature labor or stillbirth (24%), long-term infertility (12%), intensive stress in pregnancy (18%), confirmed sexually-transmitted infectious diseases (46%). In 21% cases there were chronic fetoplacental insufficiency with asymmetric small-for-gestational age fetus (I–II stage). General complaints were: psychoemotional lability, insomnia, pain sensation in lumbar and lower abdominal areas (different intensity and regularity), high fetal motor activity. 24–33 week pregnant women were taking TES-therapy. In 14 days after TES-therapy fetoplacental insufficiency was diminished as shown by ultrasonography. All women maintained pregnancy for up to 38–40 weeks. 80% patients ended up giving birth in time, 14% patients had routine surgical delivery, 6% – urgent surgical delivery. Average Apgar score for newborns was 7–8 scores. Postlabor period was going uncomplicated, without fever. Before and after labor all women were noting an improved psychological state. One may consider that TES-therapy is an effective therapeutic and prophylactic approach that may be used in case of late miscarriage, as well as chronic fetoplacental insufficiency and intrauterine hypoxia.

## **24. Use of Transcranial Electric Stimulation in Treatment of Threat of Habitual Noncarrying of Pregnancy**

*Leyderman N. E., Chizhova G. V., Tyo L. V., Verkhovtseva M. Yu., Kirpaneva E. V., Suslova N. F.*

We examined psycho-vegetative status in 30 women threat of habitual noncarrying of pregnancy at second and third trimester. As a therapy of a threat of habitual noncarrying of pregnancy and all revealed disturbances we applied transcranial electric stimulation. There was found that in 97% women we observed substantial positive effect, in particular, by formation of psycho-vegetative equilibrium as well as relieving symptoms associated with threat of habitual noncarrying of pregnancy.

## **25. Effectiveness of TES-therapy in Postoperative Maintenance of Patients after Elective Gynecological Surgery**

*Vovk A. V., Kiryanova V. V.*

In our study we found that TES-therapy significantly reduces or avoids medicine-taking (analgetics) in early postoperative period after gynecological surgery (semiotic hysteromyoma, adenomyosis, ovarian tumors, uterine and vaginal descent and prolapse). We showed that TES-therapy had a marked psycho-correcting effect on these patients. Such non-pharmacological approach had several benefits letting it to be widely used for postoperative maintenance: high tolerance, non-invasiveness, very few contra-indications, lack of side effects. TES-therapy is easy-to-use, and can be applied at any comfortable conditions.

## **26. Non-pharmacological Treatment for Rehabilitation after Organ-preserving Surgery on Uterus**

*Kulagina N. V., Kustarov V. N., Iovel G. G., Ismailova I. B.*

In our study we examined women after myomectomy. Starting from day 8–10 postoperative period all patients were given a stage rehabilitation treatment at the day hospital. At first stage patients were treated by hirudotherapy. Next stage was begun after women had restored regular menstruation. For this, patients received TES-therapy according to cyclic changes of  $\beta$ -endorphin concentration (decreased values at middle luteal phase). During follicular phase TES-therapy was applied from 5 to 9 days of cycle, during luteal phase – from 20 to 24 days. Hirudotherapy and TES-therapy recommended to patients in postoperative period increase effectiveness of reproductive function recovery in this group of patients. It was confirmed by data showing that within two years after therapy more than 50% patients had an establishment and maintenance of pregnancy. Moreover, applied rehabilitation treatment allows to prevent development of adhesive process or reduce its rate, and to improve regeneration near the scar site.

## **27. Therapy of Fibrocystic Disease of the Breast in Patients with Hysteromyoma**

*Kulagina N. V.*

Conservative therapy for treatment of hysteromyoma consisted of TES-therapy combined with use of Indole-3-carbinol (Indinol). TES-therapy was applied at middle follicular phase (5 procedures) as well as middle luteal phase (5 procedures). In patients at pre-menopausal age having low ovarian reserve TES-sessions were applied starting from day 6 till day 15 of menstruation (10 procedures). Next, patients were given Indole-3-carbinol for 8–12 weeks, 400 mg/day. A profound positive dynamics in clinical picture of different breast benign conditions was shown. This therapeutic approach turned out to be quite effective in treatment of patients with different types of fibrocystic disease: clinical signs of mastodynia disappeared in 63.4% cases, had reduced intensity in 22.5%, and psycho-emotional state was normalized in 26.7% cases. Moreover, according to mammography 33.7% women had positive dynamics of X-ray pictures one year later after starting treatment, whereas the rest of patients (66.3%) were found to have it stabilized.

## **28. Assessment of Effectiveness of TES-therapy in Treatment of Patients with Climacteric Syndrome as well as after Gynecologic Surgery**

*Andreeva M. V., Andreev V. A.*

Use of TES-therapy to treat patients with climacteric syndrome was found to be highly effective and adequate, depending on severity of climacteric syndrome and pathogenetic feasibility. Combination of TES-therapy with Sagenit had a positive effect in 92% cases with moderate climacteric syndrome and 86.79% – with severe course. In addition, it contributed to transformation of severe forms into moderate, and speeded up alleviation of the main symptoms. Use of TES-therapy to treat postoperative complications in patients with hysteromyoma led to normalization of autonomic regulation, psycho-emotional state, and improved life quality after hysterectomy. It is worth noting that TES-therapy allowed to reduce 6.1 – fold use of analgetic drugs during early postoperative period, and to shorten stay in hospital by 1.91 bed days.

## **29. Use of Transcranial Electric Stimulation in Treatment of Urinary Bladder Dysfunction in Women**

*Ziyatdinova G. M., Niauri D. A.*

In our study we found that TES-therapy was clinically effective in patients with hyperactive urinary bladder without detrusor hyperactivity, irrespective of patient's age. In case of detrusor hyperactivity TES-therapy

was complementing clinical effect from pharmacological therapy. Positive effects after TES-therapy in patients with urinary bladder dysfunctions were not only due to targeting symptoms typical to the hyperactive urinary bladder syndrome, but also due to the lack of side effects. Importantly, TES-therapy may be used as a part of domiciliary treatment with individual portable TES-units.

### **30. Induction of Sexual Maturation in Pigs by Using Transcranial Electric Stimulation**

*Sein O. B., Sein D. O.*

Here we report the results of study by estimating an effect of transcranial electric stimulation on sexual maturation in pigs. According to behavioral and hematologic tests TES-therapy did not alter life style in replacement gilts, elicited an increase of ovary weight, and contributed to increase of a number of ovulating follicles. It seems that effects of TES therapy may be mediated by stimulation of  $\beta$ -endorphin production found to be increased after TES sessions.

## **V. EFFECT OF TRANSCRANIAL ELECTRIC STIMULATION ON CARDIO-VASCULAR SYSTEM**

### **31. Effect of Transcranial Electric Stimulation of Brain Endorphinergic Mechanisms on Blood Biochemical Parameters, and Morphology of Cardiomyocytes in Rats with Experimental Heart Attack**

*Borisenko V. G., Kade A. H., Porhanov V. A., Mogilnaya G. M.,  
Dudeski V. I., Gubareva E. A., Absalyamova S. O.*

Application of transcranial electric stimulation (TES) prior to induction of experimental heart attack leads to increase of blood  $\beta$ -endorphin, thus reducing metabolic activity in cardiomyocytes, mostly via functional reorganization of mitochondria. Normalized biochemical parameters specific to cardiologic profile (troponin-1, creatine phosphokinase MB, aminotransferases) could refer to adaptation of myocardium to ischemia, indirectly implying reduction of its ischemic damage. In addition, TES-therapy enhances resistance of cardiomyocytes to ischemia, similar to ischemic pre-conditioning (to some extent as an opiate-dependent pre-conditioning). These data were confirmed by histologic and histochemic observations, unveiling that if TES-therapy was used first it leads to minimization of pathologic changes in cardiomyocytes, which is considered to be protective. It is believed that such prior TES-therapy in clinic can prevent development of recurrent ischemic attacks, and reduce damage of myocardium during ongoing myocardial infarction and decrease area of lesion.

### **32. Use of TES-therapy for Correction of Oxidative Stress under Acute Heart Attack**

*Gubareva E.A., Kade A.Kh., Pavlyuchenko I.I., Basov A.A., Zingilevski K.B., Borisenko V.G., Staricki A.G.*

Antioxidant system in patients with large-focal myocardial infarction was estimated by measuring activity of antioxidant enzymes in erythrocytic suspensions: catalase from intact cells and red cell ghosts, superoxide dismutase, as well as total serum antioxidant activity. TES-therapy in complex treatment of acute heart attack leads to inhibition of free-radical oxidation both in blood serum and red blood cells, as well as restoration of activity of the first line antioxidant enzymes, thus, reducing intensity of oxidative stress.

### **33. Improved Effectiveness of Antihypertensive Therapy by Using Transcranial Electric Stimulation**

*Zyuzina N. A., Eliseeva L. N., Kade A. Kh.*

There was found that the highest effectiveness TES-therapy alone had in case of hypertensive disease, stage I, followed by additional courses in 1–2 months. In case of hypertensive disease, stage II and III, TES-therapy was effective when applied in combination with reduced amount of medicines, with repeated courses in 2–3 months. Antihypertensive effect from TES-therapy in patients with hypertensive disease was mediated by rebuilding of microcirculation, in particular, reduction of spastic effects on its resistive part as well as correction of abnormal types of microvasculature. TES-therapy maybe considered as one of alternative approaches for correction of microcirculatory disturbances in patients with hypertensive disease, stage I, as well as an additional method for complex pharmacological therapy of patients with hypertensive disease, stage II-III. We propose that TES-therapy can be widely used in in-patient and out-patient hospitals, including sanatorium-resorts.

### **34. Orthostatic Response in Rats after Hindlimb Unloading: Effect of Transcranial Electrical Stimulation**

*Tarasova O., Borovik A., Tsvirkoun D., Lebedev V., Steeves J., Krassioukov A.*

Orthostatic hypotension is a commonly observed phenomenon after exposure to microgravity and in various forms of autonomic failure. It has been suggested that insufficient activation of supraspinal structures responsible for descending sympathetic drive could play a significant role in this disorder. We examined the effect of transcranial electrical stimulation (TES)

of autonomic nuclei within the brain on the orthostatic hypotension induced by exposure to simulated microgravity using a hindlimb unloading model. There were 20 male Wistar rats that were suspended by their tail with the angle of elevation between the cage floor and the rat's body approximately 40°. There were 11 age-matched Wistar rats used as cage controls. Orthostatic stability was examined by using an orthostatic challenge test (45° head-up test for a period of 3 min). In 10 rats from the tail-suspended group, the orthostatic challenge test was applied during TES. In the rats exposed to simulated microgravity (tail suspension), the orthostatic challenge test caused a significant decrease in mean arterial blood pressure by  $18.4 \pm 2.2\%$ . TES attenuated this microgravity-induced orthostatic hypotension to  $9.5 \pm 1.8\%$  ( $P < 0.05$ ), which was similar to the observed response to an orthostatic challenge in the control group ( $6.9 \pm 1.1\%$ ). Results of this study suggest that TES significantly reduces the changes in blood pressure during an orthostatic challenge test in animals exposed to simulated microgravity. Our observations support the notion that a reduction in descending sympathoexcitatory input from supraspinal structures could contribute to orthostatic hypotension and intolerance observed in astronauts following their return from spaceflight.

### **35. Use of Transcranial Electric Stimulation for Correction of Psychophysiological State in Sportsmen**

*Vinogradova O. L., Tarasova O. S., Ntreba A. I., Popov D. V., Bravyi Ya. R., Vdovina N. B., Borovik A. S., Lyubaeva E. V., Bersenev E. Yu., Cvirkun D. V., Lemesheva Yu. S., Vinohodova A. G., Gusch'in V. I., Sharova A. P., Trusov S. V., Lebedev V. P.*

Application of Transcranial electric stimulation in apparently healthy young people, who regularly go in for sports, was found to facilitate an increase of mental performance as well as induction of changes of nervous and hormonal regulation of vegetative functions. There was found that even after first TES-session sportsmen had significantly improved sensorimotor speed performance, reduced anxiety level, ameliorated mood. Moreover, examined sportsmen were feeling spontaneous satisfaction, abreaction, and hope of success. TES-therapy was contributing to relief of pre-starting anxiety (reduced hypertensive reaction prior to making a test), accelerating heart rate recovery after physical exercise. In addition, TES-therapy was smoothing hormonal fluctuations caused by physical exercise. Courses of TES-therapy were found to improve sense of health, had a homeostatic effect on control after cardiovascular system. Finally, it let to reach consistent exercise performance with less functional tension of vegetative system.

### **36. Correction of Hemodynamics in Judoists after Physical Exercise**

*Sein O. B., Ivanov V. A., Milostnoy Yu. P.*

Sportsmen after special and contest exercises were treated with TES-therapy (test group). Average in-group main physiologic parameters were compared between test and control groups. There was shown that TES-therapy was significantly reducing time necessary for recovery of physiologic body functions to the normal level in all tested sportsmen. Thus, the data from our study suggest that TES-therapy is a perspective to be used in sports medicine. It can be used for correction of functional state of organism as well as for relief of emotional tension.

## **VI. USE OF TRANSCRANIAL ELECTRIC STIMULATION IN ENHANCEMENT OF GENERAL RESISTANCE**

### **37. Study of Protective Effect of Transcranial Electric Stimulation During Lethal Influenza Infection in White Mice**

*Zarubaev V. V., Anfimov P. M., Meleshkina I. A., Kiselev O. I.,  
Malygin A. V., Lebedev V. P.*

In our study we investigated protective activity of transcranial electric stimulation (TES) in the model of influenza infection [virus A/Aichi/2/68 (H3N2)] in white mice. We found that TES-therapy applied according to the medical and preventive regimen gave rise to decrease of mortality and increase of survival in test group as compared with controls. However, after TES-therapy viral titers in lungs measured at day 3 postinfection did not significantly decrease. The data obtained allow to assume, that TES-therapy does not have strong immunomodulatory or direct antiviral mode of action, but rather can enhance non-specific body resistance, including cases of lethal respiratory infections.

### **38. Transcranial Electric Stimulation in Rehabilitation of Sickly Children**

*Vavilova V. P., Basmanova E. D., Aynetdinova A. L.,  
Perevoschikova N. K., Nechaeva I. A., Kochemasova O. I., Ushakova T. G.,  
Milkova T. Yu., Lebedev V. P., Trusov S. V.*

We have examined for the first time clinical effectiveness of transcranial electric stimulation (TES) in rehabilitation program of sickly preschool children (6-7 years old) suffering from acute respiratory viral infections. There was found out that TES-therapy had an immunomodulating effect on local immunity: significantly increased sIgA level as well as rose IgA level up to the age-specific values. Activation of nonspecific resistance factors of

the upper respiratory tract mucosa was evaluated by an increased lysozyme level and reconstitution of mucociliary transport. Positive dynamics of metabolism in myocardium, confirmed by electrocardiography, and normalization of bioelectric activity in cerebral cortex were due to optimization of homeostatic processes. Moreover, the number of highly anxious children was decreased, and they were showing positive dynamics in concentrating ability as well as improving memory skills.

### **39. Applicability of Transcranial Electric Stimulation in Maintenance of Children with School Deadaptation Syndrome**

*Perevoschikova N. K., Basmanova E. D., Vavilova V. P., Nechaeva I. A.,  
Aynedinova A. L., Trusov S. V., Lebedev V. P.*

We estimated TES-therapy to use for rehabilitation of children's home students having school deadaptation syndrome. All examined students were divided into two groups: students with significant deviations in school adaptation comprised test group, whereas students without obvious problems in school adaptation were included into the control group. During study there was found that TES-therapy had positive effect on bioelectric brain activity, stimulation of cognitive processes, increased levels of local resistance factors of respiratory tract in children. Effectiveness of TES-therapy was revealed in terms of arresting symptoms of school deadaptation and reduced duration of acute respiratory viral infection.

### **40. Immunomodulatory Effects of TES-therapy in Patients with Post-burn Secondary Immunodeficiency**

*Bogdanova Yu. A., Kade A. Kh., Hanferyan R. A.*

There were carried out clinical and immunologic study of TES-therapy effectiveness in treatment of patients with heat injury induced post-burn secondary immunodeficiency – patients with superficial burns I–II–IIIA stages, area of burn up to 20%, and patients with superficial burns, area of burn up to 15%, having area of deep burn up to 5 % (IIIB–IV). The major clinical effects of TES-therapy were reduced rate of infectious complications (3.3-fold in case of superficial burns, and 2.2-fold – in case of deep burns), accelerated epithelization process (superficial burns vs. control =  $12.1 \pm 0.32$  days vs.  $16.3 \pm 0.51$  days), as well as length of hospital stay. Moreover, after TES-therapy humoral and cellular immunity were remarkably enhanced. Level of  $\beta$ -endorphin after TES-therapy was increased from  $11.9 \pm 1.1$  ng/ml to  $17.8 \pm 1.07$  ng/ml, whereas it did not change in control group. Levels of adrenocorticotrophic hormone, cortisol, prolactin after TES-therapy were close to the values of healthy people, whereas they held high in comparison group. It is possible to assume that the major clinical and immunomodulatory effects after TES-therapy are due to production of endogenous opioid peptides found to increase.

#### **41. TES-therapy as a Part of Complex Treatment of Patients with Erysipelas**

*Kovtun E. A., Jukova L. I., Kade A.Kh., Manaeva D. A.*

In our study we found that TES-therapy as a part of complex treatment of patients with erisipelas, moderate form, had a positive clinical effect, shown as both systemic and local (site of inflammation) anti-inflammatory action. Due to high tolerability, quick arrest of pain sensation, lack of any side effects, non-invasiveness and affordability there must be noted that TES-therapy can be reasonably considered to use in complex therapy of patients with erisipelas together with traditional anti-inflammatory medicines.

### **VII. APPLICATIONS OF TRANSCRANIAL ELECTRIC STIMULATION IN OTORHINOLARYNGOLOGY**

#### **42. Transcranial Electric Stimulation of the Brain Endorphinergic Structures for Effective Treatment of the Sensorineuronal Hearing Loss: Method and Devices**

*Lebedev V., Malygin A., Ignatov V., Tsirulnikov E., Belimova A., Ponomarenko G., Yanov Y.*

Earlier we have shown that non-invasive selective transcranial electric stimulation (TES) provides a significant improvement of hearing in almost 50% patients with chronic sensorineuronal hearing loss (SNHL). The goal of the present work was to develop a method and design a device in order to increase effectiveness of this non-pharmaceutical approach. We developed and manufactured «TRANSAIR-07» unit that combines the TES therapy and simultaneous acoustic effects on auditory receptors in an inverse audiogram mode, working separately for each ear. The «TRANSAIR-07» device makes audiograms before the session, introduces them into the treatment program, accomplishes the efficiency control and corrects the treatment program during or at the end of the course. An essential efficiency increase of treatment, especially of chronic SNHL, including professional SNHL, was shown. There was revealed a significant whisper speech intelligibility increase and auditory threshold reduction, according to an audiogram up to 35 dB (especially for a speech frequency range), in 60%–90% of chronic SNHL cases. A certain restoration of impulse propagation through auditory nerves was confirmed by recording of the short-latency evoked auditory potentials. For the majority of cases, the level of tinnitus and vertigo either stopped or was considerably reduced. Standard questionnaires showed that quality of life in our patients had also improved significantly.

### **43. Use of Transcranial Electric Stimulation and Neuropeptides in Treatment of Sensorineural Hearing Loss**

*Zolotova T. V.*

A comparative study was carried out to compare clinical effectiveness of three different therapeutic approaches in treatment of sensorineural hearing loss – non-invasive endoaural electric stimulation (EES), transcranial electric stimulation (TES-therapy) and audio-active serum (AS), that contains neuropeptides. Hearing was evaluated by using computer tone audiometry before and after therapy. There was found that all three approaches had quite similar effectiveness. By using EES hearing was improved in 66% patients, TES-therapy – in 55%, and AS – in 63% patients. It was found out that TES-therapy was the most effective in case the patients had sensorineural hearing loss in combination with cerebral circulatory embarrassment of verteobasilar pool. It is associated with improved brain hemodynamics as confirmed by rheoencephalography.

### **44. Transcranial Electric Stimulation Used for Correction of Vegetative Vascular Control in Case of Nasal Hemorrhages**

*Kiselev V. V., Trushin V. B.*

Nasal hemorrhage – is a symptom that is typical to many different diseases. It is known that nasal hemorrhage holds the first place among cases of spontaneous bleedings from the upper respiratory airways. The major place in pathogenesis of nasal hemorrhage and its relapses belongs to autonomic dysfunction. Transcranial electric stimulation corrects autonomic disturbances and prevents relapses of nasal hemorrhage.

## **VIII. APPLICATIONS OF TRANSCRANIAL ELECTRIC STIMULATION IN DERMATOLOGY**

### **45. Complex Therapy of Itching Dermatoses by Using Transcranial Electric Stimulation**

*Sukharev A. V., Nazarov R. N., Bondar O. I., Patrushev A. V.*

Complex therapy of patients with itching dermatoses by using transcranial electric stimulation allows to shorten duration of healing process for cutaneous lesions by 5–10 days, and reduce 1.5–2 fold annual recurrence rate. Seemingly, it is mediated by decreasing elevated psychological stress as well as by normalizing autonomic disorders.

#### **46. Complex Therapy of Foot Hyperhidrosis in Military Service Men by Using Transcranial Electric Stimulation**

*Sukharev A. V., Nazarov R. N., Patrushev A. V., Bondar O. I.*

Complex therapy of foot hyperhidrosis which consists of transcranial electric stimulation and wearing of corrective orthoses allows to significantly reduce period of reaching clinical remission by 7–14 days, and decrease annual recurrence rate up to 2.5 fold. All these positive effects are due to reduction of elevated psychological stress as well as normalization of autonomic disorders.