

HEALING EFFECT OF SAPROPEL MUD (PELOIDS)

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Abstract

The available literature on physiological action of sapropels was analyzed and a number of provisions on their therapeutic value made. Sapropels are a powerful physiological stimulus that leads to a restructuring of a number of body systems functions. They cause a general reaction of the body, a local reaction in the lesion focus, an increase in skin and cavity temperatures, a decrease in the erythrocyte sedimentation rate, contribute to a decrease in the number of leukocytes, f hemodynamic shifts, shifts in the autonomic nervous system and regulate its functions. Sapropels affect cardiovascular system by increasing heart rate, changes in ECG, basal metabolic rate, cardiac output and heart systolic volume, as well as changes in arterial and venous pressure. Great importance in the influence of sapropels have temperature factor, their mechanical, physicochemical and biological properties. The results of experimental and clinical studies indicate that sapropels can successfully treat various etiology joints inflammatory diseases, diseases of peripheral nervous system, inflammatory processes of the female genital area, skin diseases, vibration disease, hepatitis, diseases of the gallbladder and biliary tract, traumatic injuries of peripheral nerves of the extremities, conditions after nerve suture or neurolysis surgery, and also they may be used antioxidants.

All human studies were conducted in compliance with the rules of the Helsinki Declaration of the World Medical Association "Ethical principles of medical research with human participation as an object of study". Informed consent was obtained from all participants.

Keywords: *sapropels, therapeutic effect, peloid therapy*

Introduction

Sapropels are silt, mostly organic deposits of flora and fauna, mainly of freshwater bodies, formed as a result of decomposition under the influence of microbiological activity [1].

Sapropels are found in Ukraine, mainly in the forest medical-geographical area, but have not been studied for use in medical practice.

But their biological activity is one of the parameters that allow us to predict a fairly high therapeutic efficacy of peloids and the prospects for their use in practical medicine. Biological activity is an integral concept, which includes a number of criteria such as peloid enzymatic activity, intensity of microbiological processes, antimicrobial properties against a number of opportunistic and pathogenic microorganisms, the presence of pharmacodynamic components, as well.

Today the lack of data on the therapeutic use of sapropels is a significant inhibitory factor in the development of peloidotherapy in Ukraine. Therefore, the **purpose of this work** was to fill this information gap as adequately as possible.

Results

In [2], experimental materials on the Lake Moltaevo (*Ozero Moltaevo*) sapropels' mechanism of action are presented. It is established that local mud applications of this sapropel cause a number of natural and characteristic changes in the indicators of the functional state of the cardiovascular system (CVS).

A two-phase reaction is the most characteristic for mud application, which is manifested at the beginning of the application by an increase in blood pressure, cardiac output and systolic volume, heart rate and respiration. By the end of the mud procedure, there is a decrease in these indicators below baseline. Changes in peripheral vessels are ultimately characterized by depressor effect, which gradually increases by the end of the application.

The two-phase reaction of CVS is due to the complex action of the mud procedure. First it is a complex reflex phase, associated with the thermal factor of application and which is carried out by the type of skin-visceral reflex. In the development of the second - neurochemical phase of changes - the specific action of sapropel itself, due to its biological

and chemical properties is the leading link. In this phase, in addition to cutaneous receptor apparatus, a large role belongs to the interreceptors of the vascular system.

The most intense reaction is with a developed balance of excitation and inhibition and high tone of the cerebral cortex, in which the conditioned reflex activity of animals occurs at an optimally high level. That is, the initial functional state of the cerebral cortex, preceding the application of mud, significantly affects the rate of manifestation and the magnitude of CVS reactions. The latter must be taken into account when assessing the therapeutic effect of mud procedures on the body and keep in mind the specific forms of the relationship between the state of cortical activity and the reactivity of the body, established in the experiment.

In the course use of mud applications, a significant role in the nature of the cardiovascular reactions of the body belongs to the conditioned reflex connections, which for some time accelerate and enhance the manifestations of the unconditional reaction and increase the physiological effect of mud procedures.

Sapropel mud from the Lake Moltaevo in the experimental conditions does not cause sharp changes in the hemodynamics of the body as a whole, which is consistent with clinical data and makes it possible to expand the list of indications for the use of this mud in diseases with concomitant cardiovascular pathology.

For the first time a comprehensive study of the therapeutic effect of sapropels is presented in [3], which presents the works of clinicians and experimenters on the effects of sapropel mud on CVS, metabolic processes, active mesenchyme and blood composition, as well as work on sapropel mud use in diseases of the joints, peripheral nervous system, traumatic injuries of the musculoskeletal system, infectious hepatitis in children, a number of skin diseases and hypertension. Positive data obtained by the clinicians have been tested in practical medical institutions. Based on scientific data confirmed by practice, it is possible to widely recommend sapropel as a treatment agent for many diseases, both in resort and out-of-resort practice.

The generalization of these data is presented in the review [4].

To recommend sapropel for widespread use in medical institutions on the basis of the authors' observations of their positive effect, it is necessary to test their effect on CVS according to the authors' method (sapropel applications 20-25 kg at 38- 44 °C every other day № 14-16).

To this end, the authors studied: a) ECG dynamics; b) changes in basal metabolism, cardiac minute output (CMO) and systolic heart volume (SHV); c) volume of blood circulation; d) blood velocity; e) venous and arterial pressure and g) capillaroscopy before the procedure and at the end of its action in 15-20 min. At the same time, CVS state was monitored during the course of treatment of various diseases.

The largest number of observations was performed in infectious and rheumatoid arthritis patients, who had mainly changes in the heart muscle (based on clinical and radiological data); they used sapropel applications on the lower extremities at a temperature of 38° C.

By the end of the procedure according to electrocardiographic parameters there was a slight increase in heart rate in 50% of patients on average within 6 beats; in 30 minutes after the end of the procedure pulse reverted to its original state. In 10% of cases, prolongation of atrioventricular conduction was noted (in rheumatoid arthritis patients); slightly more often (up to 30%) there was an increase in systolic index, and these changes were almost not observed in polyarthritis patients, and were found only in hypertensive patients suffering from polyarthritis, which is why they used mud therapy.

ECGs data show that sapropel application to the lower extremities at 38 °C is not an inert procedure, but a physiological load on the heart, which is well tolerated by patients with muscular changes in the compensated state.

Basal metabolism increased at a single application at two thirds of patients and had a natural relationship with temperature. Applications at 42 °C caused basal metabolism significant increase compared with those at 38° C.

On the basis of the data obtained [4] it is established that at sapropel application of 38 °C on a shoulder girdle and extremities increase of CMO and SHV goes in parallel.

The various indicators of CMO and SHV at applications to the shoulder girdle, lower extremities and abdomen draw attention. If at applications at 38 °C on a shoulder girdle and lower extremities there was an increase of these indicators, then at applications of the same temperature on a stomach their decrease was revealed. These indicate the complexity of the mud procedures mechanism of action, namely the combination of direct vasodilatory effects on skin vessels with effects through its skin receptors and central autonomic apparatus reflexively not only on blood vessels and heart, but also on depositing blood organs.

Changes in hemodynamic parameters during treatment indicate the adaptation of the organism to this stimulant and training effect of the course treatment with sapropel applications. At the beginning of treatment, the indicators of venous pressure and blood flow velocity were within the referent figures of physiological fluctuations, while at the end, these indicators were close to the average figures.

In polyarthritis patients at the beginning of treatment, blood pressure was usually within normal or lower limits. By the end of treatment, systolic and diastolic blood pressure increased by an average of 10 mm.

Dynamics of blood pressure as a result of mud therapy in patients with different diseases shows that ABP at the majority of cases has normalized.

In addition, it is important to note that among the joint patients there were several people with concomitant hypertension with its characteristic objective data and complaints (without severe sclerotic vascular changes). By the end of treatment, their blood pressure decreased from 180-190 mm to 130-135 mm and the subjective condition significantly improved.

CMO and SHV at the end of treatment demonstrated smaller fluctuations, regardless that the latter determinations were made at applications of 42 or 44 °C.

Observations of respiration changes by the end of the procedure showed that all patients, as a rule, responded to the mud procedure by accelerating respiration by 2-4 breaths per minute.

Heart rate and body temperature, the degree of respiration acceleration depended on the temperature of the mud procedure.

During the course of mud treatment the patients' balneoreactions were often observed. Among 480 out-patient persons, 345 of them (72%) had a reaction of exacerbation. Of these, in 152 subjects the reactions were exclusively focal in nature in the form of increased pain of varying intensity and in some cases of soft tissue swelling of the affected joints. In 193 cases, focal manifestations were accompanied by general phenomena in the form of brokenness, weakness, malaise. These cases were regarded by the authors as general balneoreactions.

In 80% of cases balneoreactions appeared after the first 4 procedures and in 20% during the rest of the course of treatment.

In 42% of cases the reactions lasted one day, in 40% of cases - two days and in 18% - three days.

By intensity of manifestation: in 92% of cases there was a mild and moderate reaction in which the patient performed his usual daily routine; and 8% there was a strong reaction, when patients adhered to bed rest for 1-2 days.

Manifestation of strong reactions was in patients admitted for treatment in a state of sharp exacerbation of their underlying disease or in its subacute stage.

The dependence of treatment results on balneoreaction could not be established. The same result was obtained in patients who did not have a balneoreaction, and in patients who underwent it. However, if such reactions occur during treatment violently, it slows down the healing process.

These data indicate that the Lake Moltayev sapropels have a certain effect on body temperature, on CVS, on the condition of capillaries not only at the site of mud applications, but also in remote areas of the body as a single procedure and during treatment. A number of CVS indicators at the use of the technique under discussion has a tendency to equalize. This suggests that sapropel acts through the cutaneous receptors and vessels on the subcortical formations and cortex of the large hemispheres in a regulatory manner and, probably, humorally, produces this regulatory effect on a number of organs and functions of the body.

This regulatory effect of mud is similar to the action of other physiotherapeutic agents.

A sufficient number of observations on joints diseases patients, peripheral nervous system, skin and inflammatory processes of the female genital zone gives a general preliminary basis to judge the therapeutic value of sapropel in these diseases.

The largest number of observations was made on the treatment of patients with damages of joints. Simultaneous treatment of underlying medical conditions and comorbidities was carried out. So, at gynecological diseases mud tampons were in addition administered, at skin displays applications on the corresponding sites of skin were appointed, at an inflammation of adnexal cavities and tonsils mud was imposed on the zone of face and neck.

The vast majority of patients responded well to treatment and did not complain. Moreover, many of them noted an easier susceptibility to treatment with sapropel mud in contrast to other peloids. At the conditions of the in-patients unit some patients received two courses of mud treatment during the year.

A significant improvement (65-70%) was observed in the group of in-patients with more severe processes. The results of treatment directly depend on the duration of the disease, its clinical picture and intensity of treatment. The best results were obtained in patients with short (up to 3 years) disease and a slight exacerbation before the treatment. Intensive treatment (25-30 procedures) for one and a half months or repeated treatment in 3 months gave good results even in severe polyarthritis.

Dependence of treatment results on the etiological moment of joint pathology is not noted.

Observations for the treatment of peripheral nervous system lesions were performed mainly in patients with pathology of lumbosacral roots.

Evaluation of the relationship between the clinical picture and the effectiveness of treatment showed that a short history radiculitis are treated faster than a long-term disease.

53 women suffering from gynecological diseases were monitored. In all cases, patients had a certain positive therapeutic effect: pain subsided, pain on palpation disappeared, the affected organs decreased to normal size, the menstrual cycle was

smoothed, the general condition of patients improved.

The best results in these cases were obtained in patients with a relatively short history of the disease, when the inflammatory process was in a state of slight exacerbation. In the neglected cases with abrupt changes in the tissues, one course of treatment did not get the desired results, although even in these cases some alleviation of pain was induced.

Exceptionally favorable results were obtained in the treatment of cervical erosions with vaginal mud swabs of low temperature (40-42 °C) in combination with "panties". Erosions with a long history, where long-term intensive medical treatment did not give results, after 5-6 procedures went away and, judging by the long-term results, recurrence did not occur.

Thus, inflammatory diseases of the female genital organs at the end of the acute period, along with diseases of the joints and peripheral nervous system can be attributed to the main indications for treatment with sapropel mud.

Among patients with skin diseases there were 46 cases of eczema, 14 pustular skin lesions, 7 trophic ulcers and 6 cases of other skin diseases (psoriasis, trichophytia).

Some patients were treated on the lake, where it was possible to use fresh sapropel, followed by washing with lake water.

A group of eczema patients (n = 30) was treated with sapropel of the same lake, but in 1.5-2 months after its preparation. Procedures were released with a temperature of 38 – 40 - 42°C. Large applications, covering not only the affected zone, but also larger areas of healthy skin were used.

Sapropel muds showed exceptionally favorable effect in the treatment of seborrheic form of scalp eczema and wetting form of eczema. In the first case, after 5-6 procedures after intensive exfoliation, the affected skin was covered with fresh healthy epithelium. Moist eczema treatment lasted a little longer, but also with good results. After the first 2-3 procedures, the exudates dried up, covered with dense crusts, which in subsequent treatment fell off, exposing areas of fresh epithelialized tissue. The course of treatment of these patients is 10-12 sessions.

Positive results were obtained in the treatment of uncomplicated forms of dry eczema, especially in

patients treated on the lake. In this case, the healing process took place in waves, where the state of improvement alternated with exacerbations. After the first 4 procedures, there was a significant improvement: the itching stopped, the swelling of the soft tissues and eczematous elements disappeared. Then, after the next 2-3 procedures, there was an exacerbation in the form of a slight swelling of the tissues, maceration of the skin and a rash of individual elements, which lasted 4-5 days and was replaced by improvement.

Some patients completed treatment at this stage. In patients who continued to receive procedures, after some time, exacerbations reappeared, but less pronounced, which passed quickly. In some cases, the exacerbations were so severe that treatment had to be temporarily stopped.

The group of pustular diseases was represented by patients suffering mainly from furunculosis or widespread folliculitis. In all cases, the elimination of purulent processes on the skin, and in the chronic course of interruption of the process for the nearest period of time.

The curing of trophic ulcers requires intensive long-term mud treatment (up to 30 procedures). Healing was slow. The first procedures caused an increase in wound secretion; in the subsequent treatment, the ulcers were cleaned of purulent contents and the defect was filled with juicy pink granulations. Then the process of epithelialization passed slowly.

Probably, the beneficial effect of sapropel mud is not limited to the treatment of eczema, pustular diseases and trophic ulcers, but may be effective also in other skin diseases. This applies the use of sapropel applications in two recovered patients with epidermophytia. Significant improvement was obtained in the treatment of 4 cases of trichophytosis.

The peculiar physicochemical and biological composition of sapropel mud allows its widespread use in dermatology.

Summarizing the facts presented in [4] on the study of the physiological action of sapropels, both in a single procedure and in the treatment process, as well as two-year observations of a significant number of patients in the clinic and mud cures hospital, the authors make a number of statements

about the therapeutic value of these peloids and preliminary instructions for their therapeutic use.

Sapropel is a powerful physiological stimulus that leads to a restructuring of a number of body systems. They cause a general reaction of the body, a local reaction in the affected area, increased skin and cavity temperatures, decreased ESR, decreased white blood cell count, a number of hemodynamic changes, as well as some changes in the autonomic nervous system and regulation of its function.

Sapropels affect CVS by increasing the heart rate, changes in the ECG, basal metabolism, CMO and SHV, as well as changes in blood and venous pressure.

Alignment of a number of CVS indicators at one-time sapropel procedure and after a course of treatment proves that sapropels through cutaneous receptors and vessels regulate vegetative nervous system, and already through higher departments of a nervous system and, probably, humorally exert this regulating effects on a number of organs and functions of the body.

A number of the laboratory and clinical facts obtained suggest that in addition to the temperature factor, mechanical, physicochemical and biological properties of sapropel are of great importance.

Clinical observations suggest that sapropels can successfully be used in the treatment of joints inflammatory diseases of various etiologies, inflammatory processes of the peripheral nervous system, inflammatory processes of the female genital area and skin diseases (eczema, neurodermatitis and pustular diseases).

The forgoing facts and considerations, based on a comprehensive, albeit preliminary study of sapropel's action, allowed us recommend them for the treatment of the disease mentioned and their further widespread introduction into medical practice.

Today a number of thesis are devoted to various aspects of the therapeutic effect of sapropel peloids on the body.

Studies of sapropel mud effect on the functional state of CVS of vibration disease patients with justification of treatment techniques showed that mud therapy is an effective method of this pathology curing [5]. A significant role is played by

the temperature regime and the area of mud application.

At the initial and moderate manifestations of the disease, the most optimal and pathogenetically justified method of exposure is the combined mud applications of contrast temperatures ("short gloves" temperature 46° - 50°, "collar" - 28° - 26 ° C), which have a beneficial effect on CVS and the body as a whole. The most pronounced positive changes are observed in the peripheral vascular bed, which is manifested by an increase in skin temperature, increased hand pulse blood supply, normalization of the tone of capillaries and large vessels both at the site of application and in remote areas. Changes in the general hemodynamics are insignificant.

Comparison of the nature of the corresponding vascular reactions to the mud stimulus of different intensity revealed a more pronounced and prolonged vasodilating effect of mud applications of contrast temperatures directly at the site of their application. Applications of moderate temperatures, on the contrary, led to an increase in the tonic tension of hand vessels.

A more pronounced microhemodynamics improvement under the influence of combined mud applications of contrast temperatures is due, apparently, not only to their favorable reflex-humoral, but also pronounced local action, leading to significant formation of vasoactive substances.

The proposed method of treatment is an active and, at the same time, adequate method of exposure, which gives a high percentage of direct positive results (98%) and sufficient stability in the term 3 - 6 months (58%), and 9 -12 months (26%). Indications for its appointment are the initial and moderate manifestations of the disease in the presence of vascular disorders (angiospastic and angiodystonic syndromes), the phenomena of autonomic polyneuritis and changes in the musculoskeletal system.

To achieve high immediate results and stabilize them for the long term, it is recommended for the duration of treatment and for 1 - 2 months after it, to release from work associated with vibration, cooling and significant physical activity.

Combined applications of contrast temperatures as a simple, quite effective and economical method (which halves the duration of treatment), can be recommended for widespread implementation in

the practice of sanatoriums, day in-patient departments, medical units of industrial enterprises, etc.

As established in [6], sapropel applications significantly affect the functional state of hepatic energy apparatus, a significant and specific feature of which is the activation of NAD • H dehydrogenase zone of the respiratory chain of mitochondria.

The effect of sapropel applications is accompanied by signs of low-energy shift in mitochondria, which were most pronounced after the 10th application (42°C, 20 minutes), as evidenced by signs of succinate dehydrogenase inhibition by oxaloacetic acid.

When using long courses (20 daily applications of sapropel, 42°C, 20 minutes) there is a change in the reactivity of hepatic mitochondria, which is characterized by later activation of energy processes in contrast to the first ten procedures and is accompanied by a significant decrease in endogenous succinate in mitochondria.

A course of sapropel applications significantly increases the resistance of animals to the action of sodium nitrite, which causes acute hemic hypoxia.

The model of experimental toxic hepatitis shows the ability of sapropel to stimulate regenerative processes. Sapropel applications have a normalizing effect on energy, morphology, excretory function of the affected liver and the distribution of nuclear hepatocytes according to their DNA content. The exclusion of the chemical factor of applications significantly reduces their therapeutic effect.

In the thesis [7] and article [8] is shown, that sapropel is an important factor in the system of application of natural therapeutic factors in children with environmentally burdened diseases of the gallbladder and biliary tract.

The results of the study allow to recommend the inclusion of sapropel applications to the liver and gallbladder and internal intake of low-mineralized water in medical rehabilitation programs for children with ecologically burdened chronic cholecystitis. The scheme mentioned improves biliary function, normalizes homeostasis (protein, bilirubinic metabolism), activate antioxidant system and promote the removal of heavy metals from the fluid of the child's body.

The aim of the study [9] was to investigate the effect of sapropel on the permeability of erythrocyte membranes, the content of ceruloplasmin, oxidative stress indicators in erythrocytes and serum of peripheral blood of rats in acute carbophos poisoning.

The use of sapropel significantly increases the antioxidant status of erythrocytes, as evidenced by the lack of significant changes in the permeability of erythrocyte membranes in acute carbophos poisoning against the background of treatment with sapropel. In acute poisoning by organophosphorus compounds changes the antioxidant status of erythrocytes. Decrease in erythrocytes of peripheral blood of rats at acute poisoning by carbophos activity of superoxide dismutase and peroxidase testifies to depletion of antioxidant protection.

Thus, the increase of free radical oxidation in carbophos poisoning indicates an increase in the intensity of chemiluminescence in erythrocytes and peripheral blood serum.

The lack of significant changes in oxidative stress indices in the blood of carbophos poisoned animals against the background of therapeutic and prophylactic administration of sapropel indicates the presence in the latter antioxidant properties.

Administration of sapropel to healthy animals had no effect on the studied indicators of oxidative stress and antioxidant protection. Oral administration of sapropel in acute carbophos poisoning gives a pronounced antioxidant effect, which opens further prospects for its practical use.

In the study of physicochemical bases, quantitative patterns and some features of the electrophoresis of sapropel components [10] it was found that centrifuged solutions of sapropels are suitable for therapeutic electrophoresis, because their biologically significant components (ions, trace elements, humic substances) have a pronounced electrophoretic motion, remain unchanged in the electric field and are able to penetrate through intact skin.

The practical recommendations of the author [10] are as follows. Cathode electrophoresis of sapropel centrifuges is recommended for the treatment of traumatic injuries of peripheral nerves of the extremities, such as compression of nerve trunks with partial conduction disturbance, as well as the condition after nerve suture surgery or neurolysis.

The course of treatment (20-30 procedures) should be carried out in combination with physical therapy (exercise), electrical stimulation of the muscles and massage of the affected limb.

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References

1. Therapeutic mud (peloids) of Ukraine. Part 1. / Under the general editorship of M. V. Loboda, K. D. Babov, T. A. Zolotareva, etc. - K. : Kupriyanova, 2006. - 320 p.
2. Vereshchagina V. S. Experimental materials on the mechanism of action of Moltaev sapropel: Synopsis of the thesis for a cand. degree on Biology. State Research Institute of Balneology and Physiotherapy. – Moscow, 1959. - 14 p.
3. Medicinal properties of sapropels of the Lake Moltaevo. - Sverdlovsk Regional State Publishing House, 1951.- 110 p.
4. Schaefer L. G., Milyutina E. I. , Orlov N. V. Therapeutic value of sapropels of the Lake Moltaevo // Sapropels of the Lake Moltaevo.- Sverdlovsk Regional State Publishing House, 1951.- 186 p.
5. Elmenkina Z. I. Influence of sapropel muds on the functional state of the cardiovascular system of patients with vibration disease (substantiation of treatment methods): Synopsis of the thesis for a candidate degree in medicine. Specialty 14.00.08 - internal diseases. - Izhevsk State Medical Institute. – Izhevsk, 1973. - 26 p.
6. Ioshchenko S. E. Influence of sapropel on the functional state of liver mitochondria: Synopsis of the thesis for a candidate degree in medicine. Specialty 14.00.34 - balneology and physiotherapy. - Odessa Research Institute of Balneology, 1985. - 22 p.
7. Kochergin Yu.V. The system of application of natural healing factors of the Urals in children with ecologically aggravated diseases of the gallbladder and biliary tract: Synopsis of the thesis for a doctor degree in medicine; Specialty 14.00.51 - Rehabilitation medicine, medical physical training and sports medicine, balneology and physiotherapy of FGUN "Ekaterinburg medical scientific center of prevention and health protection of workers of industrial enterprises". - Moscow, 2009.- 47 p.
8. Mud treatment and drinking mineral water use for the treatment of diseases of the hepatobiliary system in children in different environmental conditions / Yu.V. Kochergin et al. // Physiotherapy, balneology and rehabilitation. - 2009.- № 1.- P. 33 - 37.
9. Terekhina N. A., Zorin M. G., Terekhin G. A. Influence of sapropel muds on indicators of oxidative stress and antioxidant protection in acute carbophos poisoning // Pathological physiology and experimental therapy. - 2001.- № 1.- P. 6–8.
10. Glazkova L. P. Physico-chemical bases, quantitative regularities and some features of electrophoresis of sapropel components: Synopsis of the thesis for a candidate degree in medicine; Specialty 14.00.34 - balneology and physiotherapy.- All-Union Scientific Center for Medical Rehabilitation and Physical Therapy. - Moscow, 1988. - 28 p.