

Anti-Inflammatory Activity of the Sea Coastal Lake Salt in a Combination to Ultrasound

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It was shown that the soft medicinal form with complex of mineral salts in the combination with low frequency and therapeutic ultrasound has high anti-inflammatory activity at the model of carrageenan-induced inflammation. The low frequency and therapeutic ultrasound can be used as a physical skin permeation enhancer for transdermal administration of mineral salts. The use of ultrasound and complex of minerals salts returns morphological and biochemical parameters of experimental animals blood to normal levels after the inflammation.

Keywords: Inflammatory process; Ultrasound; Frequency; Intensity; Sea coastal lake salt; Biochemical parameters

Introduction

Ultrasound (US) is the physical factor, widely used in medical rehabilitation and balneotherapy, which has a direct therapeutic effect and can be used as a transdermal penetration enhancer when combined with drugs [1-3].

Therapeutic treatments with ultrasound can cause the analgesic, antiseptic, vasodilation, resolving, anti-inflammatory and desensitizing effects. In the application area we can observe activation of the blood and lymph circulation, increase of the phagocytosis and the mechanism of general immunological reactivity activation.

Ultrasound has depolymerized effect on the densified and sclerotic tissue. It can be used for the treatment of scars, keloids, joint contractures, and increased vascular epithelial permeability. This is the basis for the joint use with drugs for the phonophoresis [4-6].

The influence of ultrasound on biological objects is determined by the state of the object and ultrasonic signal parameters. Therefore, the selection of the optimal ultrasound parameters is very important for

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used on the basis of Kuyal'nik coastal lake salt. Was used the 5% ibuprofen ointment as the referent drug.

Four groups of animals were used for the test:

I. "Control" - the group with an induced inflammation without treatment;

II. "USlf. + SMF" – the group which was treated by simultaneous use of low-frequency US and SMF;

III. "USther. + SMF" – the group which was treated by simultaneous use of therapeutic US and SMF.

IV. "Ibuprofen" – the group which was treated by transdermal applying of ibuprofen to the inflammation place.

The interpretation of results was carried out on the basis of the dynamics changes of morphological parameters of edema (width and volume). The red and white blood cells levels and some changes of biochemical parameters (cholinesterase activity, seromucoides level, sialic acids and total protein) in the test animals blood were studied.

Results and Discussion

The influence of combined application of SMF and USther on the dynamic of aseptic inflammatory process has been investigated. Criterion the inflammatory process estimation was dynamics of width (Figure 1) and volume (Figure 2) the rat affected limb change. For comparison, the parameters of the control group (an inflammation without treatment) and groups, which was treated by etalon preparation - ibuprofen ointment were used (apply directly on the inflammation place).

The results of change dynamic width affected limb of the rat, exposed to US treatment with combination of SMF in Figure 1 are submitted.

The maximum of the inflammation increment for experimental groups was during 24 hours after the phlogogenic agent administration and consisted 60%. For control animal group the peak of inflammation was marked for the 4th day and made 90% from intact parameters.

By results of investigation it is established, that already after the

first combined use of the ultrasound with SMF on the basis of mineral salts complex, the edema width of the affected limb fast decrease (in comparison with control group approximately on 45 and 35% - for groups which treated with the use of low-frequency and therapeutic US, accordingly). During the first 4 days of an experimental inflammation we observed decrease (approximately 15-20%) of the inflammatory level of groups, which were treated simultaneously by SMF with US in comparison with ibuprofen ointment.

During the 6-12th days of experiment we did not observed statistically significant distinction between parameters of experimental groups and the group, which treated a referent-drug.

The parameters of the affected limb of rats in the experiment groups do not have differences with parameters of the intact group after eighth days of an experimental inflammation, and for control group they remained considerably overestimated.

It is

It was established, that therapeutic and low frequency US can be used as the physical enhancer of skin permeability for the mineral salts complex for reduce the inflammation.

Biochemistry of blood plasma is an extremely important factor reflecting general progress of inflammation. Primarily, this refers to quantity and activity of plasma enzymes. Specific inflammation markers are also of interest. They are inherent to each type of pathological process. We have studied activity of plasma cholinesterase (CE), total count of plasma seromucoids (SM), sialic acid (SA) concentration and total protein (TP). The great role has dynamic change of formed elements of blood also.

Studying the dynamics change of white blood cells amount has been shown, that the use of application of SMF with the US facilitate the inflammation peak phase shortening (Table 1).

For groups, which were treated by SMF with USther and USif already for the second day of experiment the tendency to the white blood cells level normalization up to the physiological norm level was observed.

Thus, it is shown, that the use of US in a combination with SMF promotes white blood cells amount returning up to a range of physiological norm on the 2nd (USther. + SMF) and the 4th day (USif + SMF), at ibuprofen application, the returning the white blood cells

amount up to normal amounts were observed on the 6th day. For the control group similar results were observed on the 10th day. Also the dynamics of red blood cells amount change was investigated (Table 2).

It is shown, that the red blood cells amount usually was within the physiological norm limits, their slightly increased amount was marked only for control group (the 2nd, the 4th and the 8th days of the experiment).

In clinical practice the biochemical markers of inflammatory process determination methods are widely applied. At the pathological process presence in an organism the ChE activity decrease is marked also. Also, at inflammatory processes as diagnostic and prognostic biochemical test use definition the SA, seromucoid and TP amount in the blood serum.

It has been shown seromucoids increase concentration (Table 3) in the blood serum of all rat test groups on second day of the carrageenan-induced inflammation.

It is shown that the use a therapeutic and a low-frequency ultrasound as a skin penetration enhancers for complex minerals salts reduced (starting from the 4th day) the concentration of seromucoids in the blood serum.

	10.6 ± 0.6*	13.2 ± 0.8*	15.2 ± 0.1	23.3 ± 0.9	21.0 ± 0.6	18.9 ± 0.4	14.8 ± 0.6*
Ibuprofen	8.9 ± 0.6*	9.6 ± 0.3*	13.9 ± 0.7	16.2 ± 0.7	12.7 ± 0.4*	11.5 ± 0.4*	12.4 ± 0.3*
USif + SMF	9.3 ± 0.5*	19.4 ± 1.0	16.9 ± 0.8	12.2 ± 0.6*	13.2 ± 0.7*	11.7 ± 0.6*	9.9 ± 0.5*
USther. + SMF	8.1 ± 0.4*	19.9 ± 1.0	14.6 ± 0.7*	13.0 ± 0.7*	12.8 ± 0.6*	11.8 ± 0.6*	9.1 ± 0.5*

* - Parameters within the physiological norm limits.

Influence of experimental treatment on the rat white blood cells level at carrageenan induced inflammation, (*109/l), (M ± m) (n=5).

	6.9 ± 0.3*		9.4 ± 0.6	8.4 ± 0.3	8.0 ± 0.5*	8.9 ± 0.4	7.6 ± 0.5*
Ibuprofen	6.9 ± 0.4*	7.6 ± 0.5*	8.2 ± 0.4*	7.7 ± 0.4*	7.8 ± 0.4*	7.6 ± 0.3*	7.3 ± 0.4*
USif + SMF	6.5 ± 0.1*	6.8 ± 0.3*	7.4 ± 0.3*	6.5 ± 0.2*	6.8 ± 0.4*	7.1 ± 0.4*	6.7 ± 0.3*
USther. + SMF	5.8 ± 0.2*	6.1 ± 0.2*	6.5 ± 0.1*	6.3 ± 0.2*	6.4 ± 0.3*	6.5 ± 0.1*	6.1 ± 0.2*

* - Parameters within the physiological norm limits.

Influence of experimental therapy on a rat red blood cells level at carrageenan-induced inflammation, (*1012/l), (M ± m) (n=5).

			2.54 ± 0.13	2.63 ± 0.03	1.85 ± 0.04	1.61 ± 0.03	1.55 ± 0.05
Ibuprofen			2.56 ± 0.12	1,37 ± 0,0*	1,51 ± 0,0*	1,23 ± 0,0*	0,91 ± 0,0*
USif + SMF	0.93 ± 0.05	1.93 ± 0.10	3.93 ± 0.10*	2.02 ± 0.20*#	1.63 ± 0.10	1.44 ± 0.08*	1.34 ± 0.07*
USther. + SMF				1.51 ± 0.08*	1.47 ± 0.09	1.33 ± 0.1*	1.31 ± 0.08*

1. * - <0.05 (in comparison with the control group)
 - <0.05 (in comparison with ibuprofen).

Influence of experimental therapy on rat seromucoids level in blood serum, (units of turbidity on Shank i Hoagland (S-H)), (M ± m) (n=5).

			3.52 ± 0.18	2.92 ± 0.15	2.74 ± 0.11	2.53 ± 0.11	2.38 ± 0.08
	2.16 ± 0.11	2.52 ± 0.13					

