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INFLUENCE OF BIOESOTHERMIC CONTROLS ON MICROCIRCULAR BLOOD WHEN DISCHARGES

(INFORMATION 1)

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Резюме: *В роботі приведено аналіз показників мікроциркуляції крові у хворих з відмороженнями. Виявлені особливості мікроциркуляції крові указують на порушення транскапілярного обміну, гіпоксію тканин, формування трофічних розладів і поглиблення некрозу, аж до ампутацій кінцівок на різних рівнях. Біоізотермічна технологія значно покращує показники мікроциркуляції (ПМ у 2,08, σ у 3,36, Kv у 1,50 рази).*
Ключові слова: відмороження, мікроциркуляція, волога камера, біоактивація (біоізотермічна пов'язка).

Summary: The analysis of the parameters of microcirculation in patients with frostbite is given. The revealed features of microcirculation of blood indicate a violation of the transcapillary exchange, tissue hypoxia, the formation of trophic disorders and the deepening of necrosis, up to the amputations of the limbs at different levels. Bio isothermal technology significantly improves the microcirculation (PM at 2.08, σ at 3.36, KV 1.50).
Key words: frostbite, microcirculation, moisture chamber, bioactivation (bio isothermal bandage).

Резюме*: В работе приведен анализ показателей микроциркуляции крови у больных с отморожениями. Выявленные особенности микроциркуляции крови указывают на нарушение транскапиллярного обмена, гипоксию тканей, формирование трофических расстройств и углубление некроза, вплоть до ампутаций конечностей на разных уровнях. Биоизотермическая технология значительно улучшает показатели микроциркуляции (ПМ в 2,08, σ в 3,36, KV в 1,50 раза).*
Ключевые слова: отморожение, микроциркуляция, влажная камера, биоактивация (биоизотермическая повязка).

Introduction. The urgent problem of burn injury and freezing is the state of local blood microcirculation, which provides trans capillary exchange and its dependence on the external and internal environments [1]. Her condition determines the adequacy of the trophic support of tissues, organs and reserves for the maintenance of homeostasis at different levels of all systems of the human body. Changes in the system of microcirculation of blood correlate with changes in central hemodynamics, which allows using the parameters of microcirculation as prognostic and diagnostic criteria for assessing the general functional state and level of health [2].

The purpose of the work was to study the dynamics of blood microcirculation in patients with frostbite using "bio-isotermic bandages" on the basis of bioactivation in a complex treatment.

Materials and methods. The study was conducted on the basis of the burn department of the Vinnitsa Regional Clinical named after M. Pirogov. The sensor of the Doppler Flowmeters LAKK-02 was applied to the skin in the upper third of the legs and fixed with a betafix (recording time is 5 minutes). Registration of transport activity of blood in "perfusion units" (pf. Un.) was carried out automatically in the program "Recording and processing of parameters of blood microcirculation" (version 2.2.0.506, July 11, 2003).

45 people were examined, of which 20 were healthy (1st group of "volunteers") and 25 victims with frostbite of the lower extremities. Of these, the 2nd group of "observation" was 15 patients, who immediately applied "bio-isotermic bandages" (Ukrainian Patent to Utility Model No. 87748) after a visit to the hospital for a cold injury site. Their structure

included the following specific elements: on the frozen feet/palms the electrode DE (electron donor) was applied. Electrode AE (electron acceptor) was applied to FAZ ST-36 (lower extremity), or FAZ PC-6 (upper limb).

To increase the conductivity of low-intensity bioelectric current, the electrodes are located on gauze pads, which are moistened with a physiological solution. Interconnected conductors, electrodes DE-AE initiated electronic transport without the use of external sources of current [3].

Then frostbitten limbs covered with PVC film insulating material up to 5 mm thickness and a second layer of PVC film. Everyone recorded a gauze bandage. The patient was given infusion therapy with solutions heated to 42-44°C. At 2-3 day surgery was performed early neurectomy and closing surgical wounds "biodegradable xenodromimplants" followed by treatment in a "wet chamber".

The third group of "comparison" was made up of 10 patients, the treatment of which was traditionally conducted using damp-drying bandages with betadine (to self-rejection of necrotic tissues, complete epithelization of granulating wounds or their surgical closure). Surveys were conducted on 2-5-10-15 and 21 observation days. The data of the observation of volunteers and patients was analyzed on the following indicators:

- Pf. Un. (an indicator of blood microcirculation, which reflects the degree of blood perfusion per unit volume of tissue per unit time and is measured in relative or perfusion units);

- σ (mean square deviation of perfusion fluctuations relative to the average transport index of blood [flacks], which reflects the average modulation of blood circulation in all frequency ranges and characterizes the stiffness of the vascular wall). The high rates of "flake" indicate a high level of perfusion and blood flow of the urinary channel;

- K_V (coefficient of variation indicates the percentage of the vasomotor component in the general modulation of blood circulation, its increase, even with a constant Pf.Un. value, indicates an improvement in microcirculation).

The results obtained were subject to variation and statistical processing for the STATISTICA-6.1 program (StatSoftInc, USA) and Ms.Excel (Windows-2007, Microsoft, USA), taking into account the average values (M), the mean error of the mean (± m) and the probability criterion (t).

Results and discussion. It was established (fig.1) that Pf.Un. at 2 days after an injury in patients with frostbite was 1.64 times lower in comparison with the indicator of "volunteers" ($P < 0.05$), and 1.26 times higher relative to the group "comparison" ($P > 0.05$). In the course of treatment (from 5 to 15 days), Pf.Un. was at the level of the initial indicator and increased by 1.29 times only for 21 days ($P < 0.05$). At the same time (remaining 1.27 times lower than the "volunteers"), it was 2.08 times higher than the indicators of the "comparison" group ($P < 0.001$).

It was investigated that (σ) mean square deviation (phlax) at 2 days of injury in patients with frostbite (fig. 2) was 3.02 times lower than that of volunteers ($P < 0.01$), and at 2,06 times higher in the "comparison" group ($P < 0.05$). Flax (σ) in patients with frostbite from 5 to 10 days decreased by 5.03 times compared with the indicator of healthy subjects ($P<0.001$) and was 1.66 times lower than the baseline ($P > 0.05$). At day 10, it increased and at 21 days was 1.76 times higher, compared with the original index ($P<0.01$). At the same time, he remained 1.72 times lower than the volunteer rate and 3.36 times higher relative to the indicator of the "comparison" group ($P < 0.001$).

It was proved that K_V for 2 days after injury (fig. 3) was 1.83 times lower than that of volunteers (P <0.01). During 5-10 days it was 1.41 times lower than in the baseline, 2.57 times in healthy subjects (P <0.001) and 1.41 times in comparison with the comparison group (P <0, 05). From the 10th day, K_V has steadily risen and at 21 days it was 1.43 times higher than the baseline (P <0.05) and 1.50 times higher than the comparison group (P <0.001). At the same time, it remained 1.28 times lower than the volunteer rate (P> 0.05).

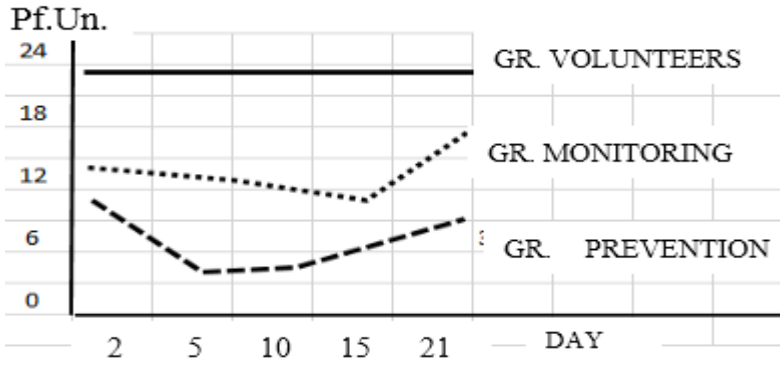

Fig.1 Dynamics of microcirculation after cold trauma in "observation" and "comparison" groups.

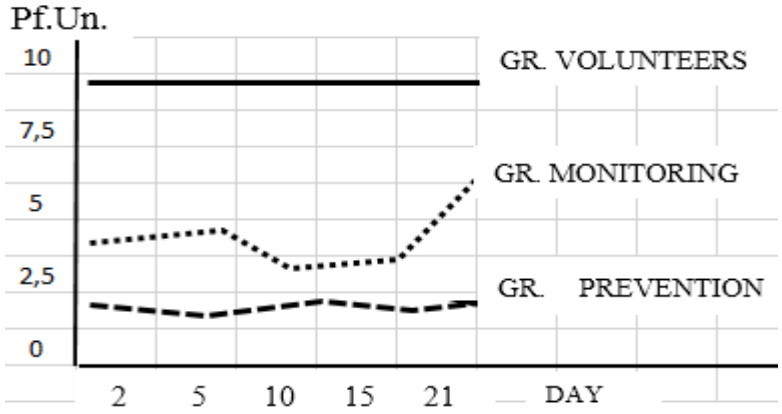

Fig.2 Dynamics of mean square deviation of fluctuations of perfusion after cold trauma in the groups of "observation" and "comparison".

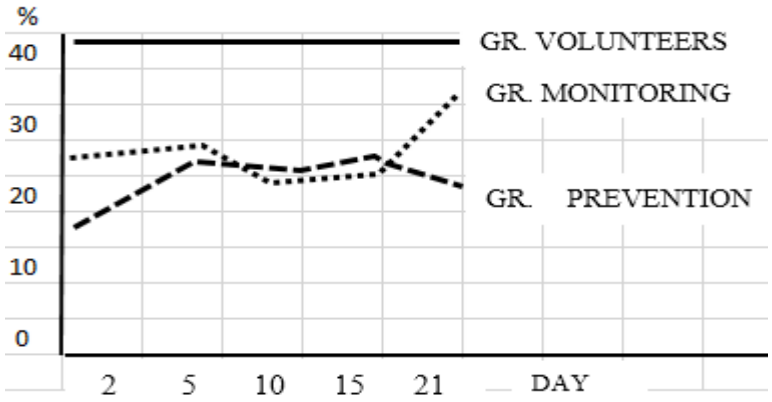

Fig.3 Dynamics of the coefficient of variation after cold trauma in the groups of "observation" and "comparison".

It is known that changes in blood microcirculation correlate with disturbances in central hemodynamics, which allows using the parameters of microcirculation as prognostic and diagnostic criteria in assessing the blood supply of injured extremities and the general functional state of health. The study confirms the violation of transcapillary metabolism, significant tissue hypoxia after cold trauma, the formation of trophic disorders and deepening of necrosis (up to the amputation of the extremities at different levels).

Bio-isothermal bandages on the limbs during frostbite, early surgical necrectomy with the closure of postoperative wounds "bioactive lyophilized xenodermic implants" and

their subsequent treatment in the "wet chamber" helped to improve the microcirculation by 21 days after injury in 2,08 times, increasing the mean square deviation of oscillations of perfusion the blood in 3,36 times and the coefficient of variation in 1,50 times (P <0,05).

Conclusions and perspectives of further development

1. The conducted microcirculation study of patients with cold trauma by the method of laser Doppler fluvometry showed significant inhibition (Pf.Un. in 1.64 times, σ in 3.02 times, K_V in 1.83 times, P <0,01).

2. The proposed technology of treatment of patients with frostbite contributed to improved blood microcirculation (Pf.Un. 2.08, σ 3.36, K_V 1.50, P <0.05).

3. Dynamics of laser doppler flowmeters is a criterion for the effectiveness of conservative and surgical treatment of patients and may contribute to timely correction of the treatment regimen.

This direction of diagnostics can be used as a component of a comprehensive program of treatment for patients with frostbite.

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