APPLICATION OF GALVANOENTEROSORPTION IN MULTIMODAL TREATMENT OF PATIENTS WITH THERMAL BURNS

Abstract. Aim — to investigate the influence of enterosorption and its combination with intra-tissue electrophoresis (ITE) of antibacterial preparations on the proteolytic and fibrinolytic activity of blood plasma in patients with common thermal burns.

Material and methods. Enterosorbtion detoxification by enterosgel was used in the multimodal treatment of 28 patients with thermal burns of II-IV stages. The drug was prescribed from 2-3 days after burn for 7-14 days, depending on the severity of the injury and manifestations of the intoxication syndrome. In 24 patients the treatment was complemented by galvanization of burn wounds with the preliminary introduction of antibacterial drugs. ITE began with 3-4 days after burn, taking into account the sensitivity of the microflora to antibiotics. The comparison group was made up of 30 patients with similar areas and depths of thermal burns receiving traditional treatment.

Results and discussion. It was discovered that the inclusion of enterosorption in multimodal therapy of burns diminished the level of unlimited proteolysis, favoured the increase of the level of blood plasma fibrinolytic activity. Its combination with ITE of antibacterial agents (galvanoenterosorption) ensured a higher therapeutic effect. Common deep thermal burns are accompanied by a significant increase in proteolytic and fibrinolytic activity (FA) of blood. Inclusion of enterosorption in the integrated therapy of burns provides reduction of proteolytic activity and maintenance of a high level of FA of plasma, which reduces the risk of thromboembolic complications.

Conclusion. Combined use of enterosorption and ITE of antibacterial agents (galvanoenterosorption) with thermal burns provides a higher therapeutic effect.

Key words: thermal burns, enterosorption, intratissue electrophoresis, galvanoenterosorption.
ing into account the sensitivity of the microflora to antibiotics. Sessions (7-14) were conducted at a time when the concentration of drugs in blood reached the maximum level: during intravenous infusions, 30-40 minutes after intramuscular injections, 1 hour after oral administration. ITE was carried out with a constant current of 0.03-0.05 mA/cm² during 45-60 minutes using a galvanic apparatus “Potok-1”. The comparison group (K gr.) was made up of 30 patients with similar areas and depths of thermal burns receiving traditional treatment.

The proteolytic activity of plasma was determined by the lysis of azoalbumin, azocollagen, azocasein. Fibrinolytic activity was studied by the azofibrin lysis with the definition of total, non-fermentative and enzymatic fibrinolytic activity (TFA, NFA, EFA). The research was conducted on the days 1-3, 6-7, 13-14 and 19-21 from the moment of burn.

**Results of the research and their discussion**

In the period of burn shock, the intensity of proteolytic degradation of low molecular weight plasma proteins (azo-albumin) exceeded the rate of healthy persons by 2.4 times.

At days 6-7 it level decreased in the main groups — respectively by 28.7 % and 38.6 % (Table 1).

After 13-14 days in K gr. it slightly increased and decreased moderately in the main groups, where it was 36.5 % and 47.3 %, respectively, lower than in the first observation period. At the same time, the difference with K gr. was 35.2 % and 42.3 % respectively. On the 19th-21st day, lysine azo-albumin did not change, while in the main groups it was by 35 % (D gr.) And 43.2 % (D gr.) Lower, compared to the baseline data and by 34 % and 42.1 % relative to K gr.

The azocollagen lysis in the first days exceeded the indicator of healthy persons by 2.2 times. On days 6-7 there was a decrease in it in all groups: by 43.8 % (D gr.), 47.1 % (D gr.) Days. On days 13-14 it declined in D gr. by 29.3 %, in D gr. - by 31.3 %, and somewhat increased in K gr., Where it was 25 % higher than in the main groups. On days 13-14 in the main groups lysis of azocasein was 31.5 % and 42.0 %, respectively, lower than the indicator in K gr. On days 19-21 in D gr. its level was 35.8 %, in D gr. — by 44.7 % lower than the initial level. During this period in D1 gr. the level of azozaezin lysis was 31.8 % lower than the indicator in K gr.

In the first 1-3 days after the burn of TFA plasma exceeded the norm by almost 3 times (Table 2).

In all groups the level of TFA during the entire period of observation did not change significantly, only in K gr. on days 19-21 it was 26.6 % lower than the initial level. In this period, in the main groups the TFA was higher, compared with K gr., However, the probable difference of 32.8 % was only in D gr. The level of NFA in the process of observation changed in the same way: on days 19-21 in the main groups it exceeded the index in K gr. by 31.4 % and 33.2 % respectively. The EFA level was about 47-49 % of the TFA throughout the observation period. Only on days 19-21 in D gr. the EFA amounted to 51.3 % of the TFA and was 32.5 % higher than the index in K gr.

The results of the study indicate that common thermal burns are accompanied by an increase in the proteolytic activity of blood plasma relative to high molecular weight and low molecular weight proteins and collagen. It enhances the toxic load on the body, potentiates the alterative processes. At the

| Groups       | Albumin | Collagen | Casein | Albumin | Collagen | Casein |
|--------------|---------|----------|--------|---------|----------|--------|
| K gr. n = 30 | 4.11 ± 0.548 | 0.59 ± 0.097 | 4.39 ± 0.329 | 3.69 ± 0.649 | 0.36 ± 0.055 | 4.50 ± 0.383 |
| D gr. n = 28 | 4.21 ± 0.548 | 0.53 ± 0.125 | 4.79 ± 0.420 | 2.99 ± 0.303 | 0.29 ± 0.05 | 3.39 ± 0.251 |
| D gr. n = 24 | 4.20 ± 0.430 | 0.36 ± 0.076 | 4.91 ± 0.379 | 2.83 ± 0.219 | 0.29 ± 0.031 | 3.38 ± 0.285 |

| Groups       | Albumin | Collagen | Casein | Albumin | Collagen | Casein |
|--------------|---------|----------|--------|---------|----------|--------|
| K gr. n = 30 | 4.30 ± 0.720 | 0.36 ± 0.069 | 4.85 ± 0.440 | 4.27 ± 0.542 | 0.39 ± 0.081 | 3.98 ± 0.452 |
| D gr. n = 28 | 2.73 ± 0.267 | 0.32 ± 0.056 | 3.32 ± 0.319 | 2.78 ± 0.215 | 0.33 ± 0.046 | 3.08 ± 0.260 |
| D gr. n = 24 | 2.46 ± 0.117 | 0.25 ± 0.045 | 2.81 ± 0.142 | 2.42 ± 0.119 | 0.20 ± 0.026 | 2.71 ± 0.233 |

Note: P – difference possibility with K gr.; P1 – difference possibility with D gr.; n – number of investigations

**Table 1**

KHARKIV SURGICAL SCHOOL № 2(107) 2021
same time, the FA of plasma increases, which may be considered as a protective mechanism aimed at improving the rheological properties of blood, preventing deepening of burn necrosis. Inclusion of enterosorption together with ITE antibacterial drugs into the complex treatment of burns contributes to a decrease of the proteolytic activity of the plasma, which provides a reduction of level of intoxication, and also allows to maintain a sufficiently higher level of FA. The latter is important in preventing the formation of blood clots and excessive formation of collagen, as the main substrate of the future scar.

Conclusions
1. Common deep thermal burns are accompanied by a significant increase in proteolytic and fibrinolytic activity of blood.
2. Inclusion of enterosorption in the integrated therapy of burns provides reduction of proteolytic activity and maintenance of a high level of FA of plasma, which reduces the risk of thromboembolic complications.
3. Combined use of enterosorption and ITE antibacterial agents (galvanoentersorption) with therapeutic plasma, which reduces the risk of thromboembolic complications.

Note: P – difference possibility with K gr, n – number of investigations

| Groups | Changes in fibrinolytic plasma activity in patients with common thermal burns (E440 nm) |
|--------|------------------------------------------------------------------------------------------|
|        | days 1-3                                                                                 | days 6-7                                                                 |
|        | TFA | NFA | EFA | TFA | NFA | EFA |
| K gr. n = 30 | 0.92 ± 0.091 | 0.47 ± 0.048 | 0.45 ± 0.044 | 0.81 ± 0.088 | 0.41 ± 0.045 | 0.40 ± 0.046 |
| D gr. n = 28 | 0.94 ± 0.081 | 0.48 ± 0.050 | 0.45 ± 0.051 | 0.84 ± 0.109 | 0.43 ± 0.061 | 0.41 ± 0.050 |
| D gr. n = 24 | 0.87 ± 0.092 | 0.44 ± 0.043 | 0.43 ± 0.051 | 0.89 ± 0.077 | 0.45 ± 0.039 | 0.43 ± 0.037 |

Table 2

Note: P – difference possibility with K gr, n – number of investigations

Conclusions
1. Common deep thermal burns are accompanied by a significant increase in proteolytic and fibrinolytic activity of blood.
2. Inclusion of enterosorption in the integrated therapy of burns provides reduction of proteolytic activity and maintenance of a high level of FA of plasma, which reduces the risk of thromboembolic complications.
3. Combined use of enterosorption and ITE antibacterial agents (galvanoentersorption) with therapeutic plasma provides a higher therapeutic effect.

REFERENCES
1. Nielsen C.B., Duethman NC., Howard J.M., M.M., Wood J.G., Burns: Pathophysiology of Systemic Complications and Current Management. J Burn Care Res. 2017;38:469-81.
2. Colohan SM. Predicting prognosis in thermal burns with associated inhalational injury: a systematic review of prognostic factors in adult burn victims. J Burn Care Res. 2010;31:529-39.
3. Petriuk B.V., Sydorchuk R.I., Khomko O.Y., Sydorchuk L.P., Petriuk T.A., Khomko B.O. The changes of burned wounds microbiocenosis under intratissue electrophoresis of antibacterial remedies. Eur J Med. 2015;7(1):29-33.
4. Koválychuk A.O., Kozynets G.P. Оцінка стану кровообігу під час термічного ураження та динаміки забруднень у хворих з опіковою травмою при місцевому застосуванні гідрогелевих регенеративних засобів та губчастих сорбуючих матеріалів. Харківська хірургічна школа. 2015;3:85-89.
5. Ravat F, Payre J, Pslages P, Fontaine M, Sens N. Burn: an inflammatory process. Pathol Biol (Paris). 2011;59:63-72.
6. Vaughn L, Beckel N. Severe burn injury, burn shock, and smoke inhalation injury in small animals. Part 1: burn class- sification and pathophysiology. J Vet Emerg Crit Care (San Antonio). 2012;22:179-86.
7. Sheppard N.N., Hemmington-Gorse S., Shelley O.P., Philip B., Dzwieński P. Prognostic scoring systems in burns: a re- view. Burns. 2011;37:1288-95.
8. Dries D.J. Management of burn injuries—recent developments in resuscitation, infection control and outcomes research. Scand J Trauma Resusc Emerg Med. 2009;17:14.
9. Koljonen V., Laitila M., Rissanen A.M., Sintonen H., Ro- ine R.P. Treatment of patients with severe burns-costs and health-related quality of life outcome. J Burn Care Res. 2013;34:318-25.
10. Sartelli M., Abu-Zidan FM., Catena F., et al. Physiological parameters for Prognosis in Abdominal Sepsis (PIPAS) Study: a WSES observational study. World J Emerg Surgery. 2019;14:34. https://doi.org/10.1186/s13017-019-0253-2.
ЗАСТОСУВАННЯ ГАЛЬВАНОЕНТЕРОСОРБЦІЇ У МУЛЬТИМОДАЛЬНОМУ ЛІКУВАННІ ХВОРИХ ІЗ ТЕРМІЧНИМИ ОПІКАМИ

О. Й. Хомко, Б. В. Петрюк, Л. П. Хомко, Р. І. Сидорчук, Т. А. Петрюк, І. В. Зазуля

Резюме Мета — дослідити вплив ентеросорбції та її поєднання з внутрішньотканинним електрофорезом (ВТЕ) антибakterіальних препаратів на протеолітичну та фібринолітичну активність плазми крові у пацієнтів із термічними опіками.

Матеріал і методи. Ентеросорбційна детоксикація ентеросорбцією (ЕС) застосовувалась у комплексному лікуванні 28 хворих із загальними термічними опіками II–IV стадій. Ентеросорбційна детоксикація з поєднанням ВТЕ антибактеріальних препаратів була використана в комплексному лікуванні 30 пацієнтів із подібними площами та глибинами термічних опіків, які отримували традиційне лікування.

Результати та їх обговорення. Встановлено, що використання ентеросорбції в комплексному лікуванні опіків дозволяє знизити рівень необмеженого протеолізу, підвищити рівень фібринолітичної активності плазми крові. Її поєднання з ВТЕ антибактеріальних препаратів забезпечує зниження рівня протеолітичної активності та підтримання високого рівня ФА плазми, що знижує ризик тромбоемболічних ускладнень.

Висновок. Комбіноване застосування ентеросорбції та ВТЕ антибактеріальних засобів забезпечує більш високий терапевтичний ефект.

Ключові слова: термічні опіки, ентеросорбція, внутрішньотканинний електрофорез, гальваноентеросорбція.
Резюме. Цель — исследовать влияние энтеросорбции и ее сочетание с внутритканевым электрофорезом (ВТЭ) антибактериальных препаратов на протеолитическую и фибринолитическую активность плазмы крови у пациентов с термическими ожогами.

Материал и методы. Энтеросорбционная детоксикация Энтеросгелем применялась в комплексном лечении 28 больных с общими термическими ожогами II–IV стадий. Препарат назначали через 2–3 дня после ожога в течение 7–14 дней, в зависимости от тяжести травмы и проявлений интоксикационного синдрома. У 24 пациентов это лечение было дополнено гальванизацией ожоговых ран с предварительным введением антибактериальных препаратов. ВТЭ начали через 3–4 дня после ожога с учетом чувствительности микрофлоры к антибиотикам. Группу сравнения составили 30 пациентов с подобными площадями и глубинами термических ожогов, которые получали традиционное лечение.

Результаты и их обсуждение. Установлено, что использование энтеросорбции в комплексном лечении ожогов позволяет снизить уровень неограниченного протеолиза, повысить уровень фибринолитической активности плазмы крови. Ее сочетание с ВТЭ антибактериальных средств (гальваноентеросорбция) обеспечивает достижение лучших результатов лечения. Распространенные глубокие термические ожоги сопровождаются значительным повышением протеолитической и фибринолитической активности (ФА) крови. Включение энтеросорбции в комплексную терапию ожогов обеспечивает снижение протеолитической активности и поддержания высокого уровня ФА плазмы, снижает риск тромбоэмболических осложнений.

Вывод. Комбинированное применение энтеросорбции и ВТЭ антибактериальных средств (гальваноентеросорбция) при термических ожогах обеспечивает более высокий терапевтический эффект.

Ключевые слова: термические ожоги, энтеросорбция, внутритканевый электрофорез, гальваноентеросорбция.