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ТИББИЁТДА ЯНГИ КУН НОВЫЙ ДЕНЬ В МЕДИЦИНЕ NEW DAY IN MEDICINE

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КОМПЛЕКСНАЯ ХИРУРГИЧЕСКАЯ ЛЕЧЕНИЯ НЕКРОТИЗИРУЮЩИХ ИНФЕКЦИЙ МЯГКИХ ТКАНЕЙ

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✓ Резюме

На сегодняшний день остаются нерешенными ключевые научные и практические вопросы: отсутствуют объективные критерии, позволяющие дифференцировать жизнеспособные и некротические ткани при НИМТ у больных с СД; не исследовано влияние современных физических методов (вакуум-, фотодинамической и плазменной терапии) на морфологию, микробиоту и репаративные процессы в инфицированных тканях; не разработан алгоритм, который позволил бы индивидуализировать объем хирургической обработки и последовательность применения физических технологий; не проведено сравнительных исследований эффективности комплексных подходов, основанных на интеграции объективной диагностики и щадящих методов санации.

Ключевые слова: Сахарный диабет, некротизирующие инфекции мягких тканей.

YUMSHOQ TO‘QIMALARNING NEKROTIZATSIYALOVCHI INFEKSIYALARINI KOMPLEKS JARROHLIK YO‘LI BILAN DAVOLASH

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✓ Rezyume

Hozirgi kunda muhim ilmiy va amaliyot masalalari hal etilmagan: diabetli bemorlarda NIYT bo‘yicha tirik va nekrotik to‘qimalarni farqlash imkonini beruvchi obyektiv mezonlar yo‘q; zamonaviy fizik usullarni (vakuum, fotodinamik va plazmali terapiya) infeksiyalangan to‘qimalarda morfologiya, mikrobiyota va reparativ jarayonlarga ta’siri o‘rganilmagan; xirurgik ishlov berishning hajmini va fizik texnologiyalarni qo‘llash tartibini individuallashtirish imkonini beruvchi algoritmi ishlab chiqilmagan; obyektiv diagnostika va engil sanatsiya usullari integratsiyasiga asoslangan kompleks yondashuvlarning samaradorligini solishtiruvchi tadqiqotlar o‘tkazilmagan.

Kalit so‘zlar: Qandli diabet, yumshoq to‘qimalarning nekrozlovchi infeksiyasi.

COMPREHENSIVE SURGICAL TREATMENT OF NECROTIZING SOFT TISSUE INFECTIONS

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✓ **Resume**

To date, key scientific and practical issues remain unresolved: there are no objective criteria for differentiating viable and necrotic tissues in patients with DM; the effect of modern physical methods (vacuum, photodynamic, and plasma therapy) on morphology, microbiota, and reparative processes in infected tissues has not been studied; an algorithm that would allow individualizing the volume of surgical procedures and the sequence of application of physical technologies; No comparative studies have been conducted on the effectiveness of integrated approaches based on the integration of objective diagnostics and gentle sanitation methods.

Keywords: *Diabetes mellitus, necrotizing soft tissue infections.*

Relevance

Diabetes mellitus is a serious risk factor for soft tissue infections. Up to 80% of patients with DM encounter some form of skin and soft tissue infection during their lifetime, with the severity and frequency of complications being significantly higher than in individuals without DM (2,4,6).

In patients with DM, soft tissue infections often progress more rapidly and involve deeper tissue layers (subcutaneous fat, fascia, muscles), which corresponds to the classification of severe forms (levels III–IV according to D. H. Ahrenholz). It is well known that DM contributes to delayed wound healing, impaired microcirculation, sensorimotor neuropathy, and angiopathy, which aggravate the course of infections and complicate surgical treatment.

Necrotizing soft tissue infections (NSTIs) represent one of the most severe forms of surgical infection, characterized by rapid progression of necrosis, a high risk of sepsis, multiple organ failure, and significant mortality (1,3,5). For example, a study conducted in Denmark demonstrated that in NSTIs the 30-day mortality rate is approximately 19%, while one year later it exceeds 30%. At the same time, diabetes mellitus (DM) was identified as the most common comorbid condition (43% of cases) among all patients with NSTIs.

Moreover, traditional treatment methods (aggressive necrectomy and repeated surgical debridement of the purulent focus) in patients with DM often lead to unfavorable outcomes, as large volumes of tissue are removed and blood vessels are ligated. This, in turn, worsens microcirculation, increases ischemia, promotes progression of the necrobiotic process, and contributes to amputations. Such circumstances necessitate new approaches to diagnosis and treatment (7,9).

Modern studies emphasize that early and radical surgical intervention is a key factor for survival in NSTIs in patients with DM. However, patients with DM have specific features—more pronounced vascular and neuropathic pathology—that complicate the choice of the optimal extent of resection and the prevention of further necrosis (6,8,10).

In clinical practice, this is manifested by a significantly higher risk of limb amputation or death in patients with NSTIs in the presence of DM. For instance, one study showed that the rate of limb amputations in patients with DM and necrotizing fasciitis was 18.1%, compared to 9.3% in patients without DM.

Given that the prevalence of DM continues to increase worldwide, the burden of complications, including severe NSTIs, will only grow.

For surgical services, especially abdominal and purulent surgery, this means an increased workload, rising costs, and the need to develop optimized management algorithms for such patients, taking into account the comorbidity of DM and physiological characteristics.

Aim of the study: To improve the outcomes of treatment of severe forms of necrotizing soft tissue infections developing in the presence of diabetes mellitus by developing and implementing optimized methods of early diagnosis and comprehensive, differentiated treatment.

Materials and methods

The clinical material included observations of patients with necrotizing soft tissue infections of various localizations and degrees of severity, confirmed by clinical, laboratory, and instrumental diagnostic methods. All 54 patients suffered from type 1 or type 2 diabetes mellitus with varying degrees of carbohydrate metabolism compensation and were treated and examined at the Bukhara Multidisciplinary Medical Center between 2020 and 2025. All patients were divided into two cohort

groups: a control group (26 patients), who underwent treatment and examination from 2020 to 2023, and a main group (28 patients), who were treated and examined from 2023 to 2025.

In patients of the comparison group, the identified soft tissue changes were represented by the following forms: necrotizing fasciitis – 24 cases (44.4%); necrotizing myositis – 30 cases (55.6%);

No statistically significant differences were found in the main group of patients, since during group formation the principles of representativeness were observed, and the parameters of soft tissue pathology as well as comorbid conditions were comparable between the groups ($P > 0.05$). Therefore, it was considered inappropriate to present and analyze these data in detail.

It is well known that the clinical picture of a disease is assessed by the presence of specific symptoms of the given pathology, and the effectiveness of any treatment method is evaluated by the dynamics and resolution of the identified clinical symptoms. We analyzed the detectability and regression of clinical symptoms characteristic of NSTIs, including reduction of perifocal inflammation and hyperemia of tissues surrounding the wound, decrease in local edema, and reduction of infiltration in the area of wound edges after the applied treatment methods.

The resolution of all the above symptoms occurred gradually, and complete resolution was not uniform. Comparative analysis showed that all parameters changed unevenly at different observation periods. Moreover, it was established that all three compared parameters in patients of the main group resolved significantly faster than in patients of the comparison group ($P < 0.001$). This indicates the high clinical effectiveness of the proposed comprehensive treatment method.

In patients of the main group, wound cleansing from pathogens occurred on average by day 5.0 ± 0.5 , accompanied by resorption of infiltration around the wound. The onset of granulation tissue formation was observed by day 7, and the beginning of epithelialization by day 10 of treatment. The mean duration of inpatient treatment was 12.5 ± 1.5 bed-days.

In contrast, patients in the comparison group demonstrated somewhat different results. Wound cleansing from pathogens did not occur even by day 10 after the start of treatment ($P < 0.001$). By day 7, resorption of infiltration around the wound was noted ($P < 0.001$). The onset of epithelialization was not observed by day 10 of follow-up; further observations showed that it occurred on average by day 19 of treatment. The duration of inpatient treatment was 23.5 ± 3.5 bed-days, which is 1.9 times longer.

Thus, in patients with NSTIs who received comprehensive treatment including LFDPT in addition to conventional therapy, clinical symptoms (reduction of perifocal inflammation and hyperemia of tissues surrounding the wound, decrease in local edema, and reduction of infiltration at the wound edges) resolved significantly faster than in the comparison group. Wound cleansing from pathogens, resorption of infiltration around the wound, and the onset of epithelialization also occurred significantly earlier than in patients of the comparison group. Furthermore, the duration of treatment in the main group was 1.9 times shorter compared with that in the comparison group. All these findings confirm the clinical effectiveness of the proposed treatment method compared with conventional therapy in patients with NSTIs.

Results and discussion

Determination of pathogen isolation rates (qualitative indicator) and the degree of wound contamination (quantitative indicator) in patients with diabetes mellitus is of great importance, since bacteriological testing allows not only identification of the etiological agents of the disease but also assessment of the microbiological effectiveness of the applied treatment methods.

Bacteriological studies isolated typical pathogens of purulent-inflammatory diseases: *S. aureus*, *S. epidermidis*, *P. aeruginosa*, *Klebsiella spp.*, *Proteus spp.*, *Enterobacter spp.* (obligate and facultative aerobes), *Bacillus spp.* (obligate anaerobes), and fungi of the genus *Candida* (microscopic fungi). Microbial associations isolated from wound biomaterial were significantly more frequent than monocultures of etiological agents. Most of the isolated strains demonstrated marked antibiotic resistance. In both comparison groups, high levels of bacterial wound contamination were detected upon hospital admission— 10^9 – 10^{10} CFU/mL.

Bacteriological examinations were performed before treatment and on days 3, 5, 7, and 10 after the start of treatment in patients of both groups.

It was established that in the comparison group, isolation of Gram-negative bacteria ceased by day 7 after treatment initiation, whereas Gram-positive cocci, anaerobes, and *Candida spp.* continued to be isolated up to day 10.

In the main group, Gram-negative bacteria showed no growth as early as day 3 after treatment initiation, while Gram-positive cocci, anaerobes, and *Candida spp.* were not isolated from day 7 onward (“negative bacteriological result”). Apparently, this effect is due to the local action of LFDPT, since identical results were observed when PDT alone was used in patients (Chapter 4).

A comparative assessment of the quantitative composition of pathogens (microbial contamination) in both groups is presented below:

- upon hospital admission: 10^8 CFU/mL in the first group and 10^{10} CFU/mL in the second group;
- 3 days after treatment initiation: 10^6 CFU/mL in the first group and 10^3 CFU/mL in the second group;
- 5 days after treatment initiation: 10^5 CFU/mL in the first group and 10^2 CFU/mL in the second group;
- 7 days after treatment initiation: 10^4 CFU/mL in the first group and “no growth” in the second group;
- 10 days after treatment initiation: 10^3 CFU/mL in the first group and “no growth” in the second group.

Thus, bacteriological study results in patients with NSTIs showed that in the comparison group, isolation of Gram-negative bacteria ceased by day 7 after treatment initiation, whereas in the main group it ceased by day 3. While Gram-positive cocci and anaerobes continued to be isolated up to day 10 in the comparison group, patients in the main group demonstrated “no growth” from day 7 onward.

Microbial contamination also differed significantly between the groups: in the comparison group, bacterial growth of 10^2 CFU/mL was still observed on day 10, whereas in the main group “no growth” was recorded already by day 7. These findings indicate that comprehensive treatment using LFDPT and Perftoran in combination with conventional therapy provides high bacteriological effectiveness, exceeding that of these methods when used separately.

At the next stage, indicators of systemic intoxication were evaluated, including dynamics of body temperature, leukocyte intoxication index (LII), and erythrocyte sedimentation rate (ESR).

Comparative analysis showed that one of the main signs of intoxication—elevated body temperature—gradually decreased in patients of the comparison group, reaching normal values only by days 7–10 of observation, whereas in the main group normalization of body temperature occurred already by day 5. Subsequently (on days 7 and 10), this parameter remained within normal limits.

At the same time, statistically significant differences between the groups were also found for the LII ($P < 0.001$), manifested by a faster reduction of elevated LII values in the main group compared with the comparison group ($P < 0.001$). Not only a rapid decrease but also a significantly faster normalization of this parameter was noted ($P < 0.001$).

Similar results were obtained for ESR. In the comparison group, ESR values before treatment and at day 10 differed by 1.7 times, whereas in the main group the difference between observation periods reached 4.7 times. Moreover, in the main group, ESR values decreased significantly to normal levels already by day 7 ($P < 0.001$), while in the comparison group they did not reach normal values even by the end of observation (day 10).

Thus, assessment of intoxication indicators (body temperature, LII, ESR) in patients with diabetes mellitus showed that in both groups all parameters were significantly elevated upon admission (before treatment) compared with normal values ($P < 0.001$), but gradually decreased after treatment. It should be noted that although parameters changed in the same direction, the intensity of change differed depending on the treatment method. After conventional treatment (comparison group), parameters decreased gradually and generally did not reach normal values, whereas after comprehensive treatment including LFDPT in addition to conventional therapy, parameters decreased rapidly and reached normal values within a short period. This demonstrates the detoxifying effectiveness of the proposed comprehensive treatment for patients with NSTIs.

The results of LFDPT application in patients of the main group ($n = 26$) showed that 44.4% of patients exhibited clinical and hemodynamic improvement by days 7–10, manifested by the appearance of fresh granulation tissue in ischemic ulcers.

Against the background of ongoing therapeutic measures, 7 patients (26.9%) in the comparison group demonstrated progression of the pathological process, necessitating staged decompressive incisions and staged necrectomies for vital indications. In 5 patients (19.2%) with limb involvement, lower limb amputation at the thigh level was performed. In 3 patients (8.33%) who underwent minor surgical interventions, progression of comorbid conditions that could not be corrected was observed, resulting in acute cardiovascular failure in 3 patients, systemic inflammatory response syndrome with development of septic shock in 2 patients, and renal failure due to diabetic nephropathy in 2 patients, all with fatal outcomes. Postoperative mortality in the control group was 3 patients (8.33%).

In the main group, despite comprehensive treatment, progression of the pathological process was observed in 3 patients; for vital indications, lower limb amputation at the thigh level was performed in 2 patients (7.8%). Mortality was observed in 1 patient (2.5%), caused by progression of multiple organ failure with refractory hypotension.

Conclusion

When choosing a treatment strategy for patients with necrotizing soft tissue infections, preference should be given to a comprehensive approach targeting all components of the pathological process (pathogens and the inflammatory response). This contributes to a significantly faster timeline for wound cleansing from microorganisms, resorption of periwound infiltration, and the onset of granulation and epithelialization. It is advisable to combine local LFDPT simultaneously with conventional therapy, as this leads to shorter rehabilitation periods and a statistically significant reduction in the number of organ-sacrificing surgical procedures.

Analysis of the structure of postoperative mortality showed that with conventional treatment of patients with NSTIs, the mortality rate was 8.33%, whereas in the main group, where treatment was carried out as a comprehensive approach including LFDPT, mortality was only 2.5%.

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