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OPTIMIZATION OF SURGICAL TACTICS BASED ON MORPHOLOGICAL CRITERIA FOR READINESS OF BURN WOUNDS FOR AUTODERMOPLASTY

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Evgeniy Martynenko[1], Tamara Obydennikova[4], Kirill Stegniy[1], Ivan Reva[1,2], Marina Fleischman, Aleksandr Zolotov[1], Dmitriy Zvyagintsev[1], Sergey Terekhov[1], Olga Lebedko[3], Igor Sementsov[1], Ellada Slabenko[1], Galina Reva✉, Viktor Usov[1]

[1] Far Eastern Federal University, Vladivostok, Russia
[2] International Medical Education and Research Center, Niigata, Japan
[3] Far Eastern State Medical University, Khabarovsk, Russia
[4] Pacific State Medical University, Vladivostok, Russia

✉ *RevaGal@yandex.ru*

ABSTRACT — With the permission of the Ethics Committee of the Far Eastern Federal University and in accordance with Russian legislation and the Declaration of Helsinki (2013), immunohistochemical studies were carried out and morphological criteria were developed for the readiness of burn wounds for autodermoplasty with predicted efficacy. The aim of the study was to optimize active surgical tactics in the treatment of burns with the development of morphological criteria for determining the timing of effective autodermotransplantation. The analysis of the material in 4 groups of patients was carried out: group 1 with autodermotransplantation in the first 7 days (32 patients); 2nd group — after 7 to 14 days (24) and after 14 days due to the insufficient number of Lonor sites (4), as well as with the final covering of wounds even at a later date due to rejection and microbial contamination in the wound after 21 days (2 patients). It was found that the optimal time for complete covering of burn wounds is 7–8 days after thermal injury. On the 9–14th day, the conditions for autodermoplasty are preserved, but in the wounds the phenomena of scar tissue formation and vascular hardening occur. In terms later than 14 days after the injury, the conditions for autodermoplasty worsen, the effectiveness of treatment decreases and is accompanied by the healing of the tissue defect with scarring. Autodermoplasty after 2 weeks is accompanied by a decrease in reparative processes with the induction of pathological angiogenesis, an aggressive reaction of immunocompetent cells with non-infectious destruction and lysis of the graft, which requires significant correction of therapeutic measures.

KEYWORDS — skin, burns, regeneration, immunocytes/phagocytes, restitution, autodermoplasty, active surgical tactics.

RELEVANCE

Severe thermal injuries at the present stage remain one of the most difficult problems of clinical medicine, occupying the 3rd place in the general structure of injuries, and patients account for more than 10% of those injured in peacetime [1]. Burn size, accounting for more than 60% of the total area of the burned body surface, is associated with risks and mortality [2]. Improper initial treatment or delaying treatment may adversely affect subsequent outcomes. Major burn treatments and approaches include dressings, antimicrobials, fluid resuscitation, burn wound excision, skin grafts, and the use of skin substitutes [3]. With extensive severe and deep damage to the skin, along with detoxification and correction of metabolic disorders, immunocorrection and autodermotransplantation are necessary. [4].With deep second-degree and third-degree burns, the epidermis and appendages of the skin are destroyed, so that healing can only occur with severe scarring. In these cases, necrectomy and skin grafting are recommended [5]. The prognosis of the effectiveness of therapeutic measures depends on the chosen strategy and tactics for managing burn patients, based on determining the optimal surgical tactics and timely autodermoplasty[6, 7]. For successful healing and regeneration, stabilization of blood circulation is necessary, intensive infusion therapy. To eliminate the risk of infection, early necrectomy and skin grafts with exfoliation are performed. In addition, the success of treatment depends on other factors. The key issue is to determine the readiness of not only the burn wound for graft transplantation, but also the possibility of re-sampling of material from the donor site [8, 9]. An effective response to extensive burns requires well-coordinated institutional efforts and preparation for treatment with predictable results based on objective indicators [10], which determined the direction of our research.

The aim of the study was to develop morphological criteria for the readiness of a burn wound for autodermotransplantation and a donor site for repeated sampling of material within the framework of modern standards and innovations for active surgical tactics in the treatment of burns.

MATERIAL AND METHODS

With the permission of the Ethics Committee of the Far Eastern Federal University, studies were carried out on 62 patients aged 18 to 60 years with thermal burns who were treated at the Primorsky Burn Department of Far Eastern Regional Medical Center" (Russia) in the period from 2007 to 2016.The inclusion criteria were the presence of IIIA-IIIB burns with an area of 10 to 20% of the body surface, as well as deep IV degree burns, in accordance with the requirements of the Ministry of Healthcare of the Russian Federation dated 04.29.94 No. 82 and according to the nomenclature of clinical laboratory studies of the Ministry of Health of the Russian Federation (Order No. 64 of 02/21/2000 y.) taking into account the provisions of the Helsinki Declaration (2000–2013). The exclusion criteria were the presence of a large area of superficial I and II degree burns in the victims. Also used 16 biopsies of cadaveric material of the skin of patients without pathology. To study the dynamics of morphological changes in all patients, after obtaining a written voluntary consent, a biopsy material was taken from burn wounds under local anesthesia in the dynamics of healing during treatment of wounds according to clinical indications. The size of biopsies was no more than 1–2 mm^3. Depending on the objectives of the study, the material was collected at different times. Depending on the timing of covering the burn wounds, all patients were divided into 4 groups: the first included victims who underwent the final stage of autodermoplasty in the first 7 days (32); Group 2 — after 7 to 14 days (24) and after 14 days due to the insufficient number of Lonor sites (4), and with the final covering of wounds even later after 21 days (2 patients). Potential homogeneous subgroups of dermal biopsies were investigated using cluster analysis in accordance with the principles of evidence-based medicine. A classical morphological research method was used with staining of sections with hematoxylin and eosin, followed by analysis of the obtained illustrative material. To quantify the regenerative potential of burn wound tissues, the expression of the Ki-67 gene was studied using a panel of mono- and polyclonal antibodies to this antigen, followed by staining with hematoxylin. Immunohistochemical identification of immunocompetent cells (Langerhans cells, macrophages, CD-4, CD-8) was carried out according to the same scheme, despite the different localization of the antigen in cellular structures: membranes, lysosomes, nuclei, Golgi complex. Retrospective assessment of the lesions was carried out according to the morphological features observed using the Olympus Bx 52 microscope. All patients received standardized treatment: infusion, antibiotic therapy, drugs for the prevention of acute stress ulcers of the upper gastrointestinal tract, disseminated intravascular coagulation. In local treatment, an active surgical approach was followed in order to remove necrotic tissue as early as possible. Thus, surgical necrectomy was performed in 55 (88.7%) patients, necrolyticnecrectomy was performed in 5 (8.1%) patients, spontaneous rejection of a scab of some small wounds occurred in 33 (53.2%) burned patients. The data obtained were statistically processed on a PC using Excel 2010 for Windows 10.

RESEARCH RESULTS

With extensive wounds (Fig. 1) against the background of an open skin defect, partially replaced by subcutaneous fatty tissue, healing occurs with the formation of fibrinous-purulent exudate. Suppuration should be considered as a process of biological cleansing of damaged tissue with the participation of bacterial proteases and macrophage hydrolases [11]. In burn wounds covered up to 7–9 days, the content of macrophages and Langerhans cells in biopsies obtained on border of autodermotransplant and intact skin. It was found that in the case of complete engraftment of the autodermotransplant, the content of Langerhans cells increases sharply starting from the first day after autodermoplasty, reaches a maximum value on the 3rd day and remains at a high level until the 7th day, which corresponds to the deployment of active processes of angiogenesis and engraftment of the skin graft. After the completion of the processes of formation of a single vascular network of the wound bed and autodermotransplant, the number of these cells decreases sharply and corresponds to those in normal skin. These data indicate the restoration of the barrier properties of the epidermis and a decrease in the number of antigen-presenting cells. The number of cells of the macrophage pool also decreases, which corresponds to the formation of a viable skin flap and a decrease in the number of contaminating microorganisms on the surface of the epidermis and necrotic cells that need to be utilized. It is noted that the success and effectiveness of the treatment are dependent on the timing of the treatment with autodermoplasty (Table 1; Fig. 2).

Re-autodermoplasty was successful after preparation of the wound surface and removal of granulations.

At the same time, it was noted that from the first to 7 days in the infiltrate and under the scab there is a high regenerative potential of keratinocytes, as well as a high content of CD4+ and macrophages expressing CD68. From 7 to 14 days, their number stabilizes, and, starting from the 14th day, decreases, which indicates the depletion of the regenerative potential. In the donor site, after taking the autodermotransplant, the high regenerative potential does not correspond to the

Figure 1. *Patient on the 2nd day after admission; extensive burn wounds after severe thermal injury. Limited ability to take donor material. The need to re-take autodermotransplant from donor sites*

Fig. 2. *10 days after admission to the hospital and treatment with active surgical tactics with necrectomy and autodermoplasty and early terms*

Table 1. *Characteristics of the results of treatment of deep burns depending on the timing of autodermoplasty*

Terms of the final stage of ADP (days)	Complete engraftment of the graft		Partial lysis of the graft		Complete lysis of the graft	
	Abs.	%	Abs.	%	Abs.	%
up to 7	32	81,3	2	12,5	1	6,3
9–14	23	76,9	2	15,4	1	7,7
Later 14 to 21 days	5	65,6	3	9,4	8	25
After 21 days	0	50	1	50	1	50

**ADP — autodermoplasty*

restoration of the barrier properties of the epithelium, therefore, the best indicators for re-sampling of the material reach on the 9–10th day.

CONCLUSION

Adequate treatment of burn injuries, taking into account the data obtained and the recommendations developed on their basis, improves the outcome of thermal injury for patients. The rational introduction of methods for treating burn wounds using morphological criteria for the readiness of burn wounds for autodermotransplantation is recommended. Timely active surgical tactics can speed up the healing of burn wounds and increase the efficiency of autodermoplastat engraftment.

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