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The experience of critical burn injury treatment in pediatric practice

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Abstract

Patients with severe burn injuries require specialized medical care. For many decades, burn injury in children remains an important issue both in medical and social-economic aspects. It is explained by the high frequency of this pathology, prevalence among all age groups of the population, severe clinical course accompanied by the multiple organ failure development. About 400 thousand burns per year occur in Russia, 35–40% of them affect children. A burn injury often leads to fatal outcome, disability and reduce of the quality of life. Wound infection associated with the burn injury in children remains a topical problem of modern combustiology. The authors present the clinical case of successful treatment of Patient M., born in 2005. The patient was transferred from the city M. to the burn center of University Clinic of the Privolzhsky Research Medical University in Nizhny Novgorod on the third day after getting the injury. During the hospitalization period in the burn center, the patient underwent complex treatment: infusion-transfusion therapy under the hemodynamic and laboratory indicators control, antibacterial and anticoagulant therapy, nutritional support by a combined method, symptomatic treatment, active surgical tactics (necrectomy by bordering incisions using modern wound hydrocolloid coatings, autologous skin grafting). In skin grafting operations, a high perforation coefficient of split grafts was used (1:6, 1:3). The success of treatment was determined by the creation of an optimal wound environment for the autografts' engraftment, the absence of regression, which made it possible to restore the skin integrity in a short time, and to avoid complications of the burn disease course. Thus, the early transfer of a child with a severe injury into a specialized burn center, intensive therapy, active surgical tactics, the use of modern wound coatings in the treatment of a patient with a critical area of deep burn injury made it possible to successfully restore the skin in a short time of hospitalization.

Keywords: burn injury, hydrocolloid coatings, autologous skin grafting.

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Patients with severe burn injuries need specialized medical care [1]. For many decades, thermal injury in children has remained an important not only medical but also socioeconomic problem. This is due to the high incidence of this pathology, prevalence among all age groups, and severe clinical course accompanied by multiple-organ failure [2]. Every year in Russia, burns are registered in approximately 400 thousand patients, 35%–40% of which are children. A burn injury often ends in lethal outcomes, causes disability, or decreases the quality of life of the patients [3, 4]. Moreover, infection of burn wounds in children is an urgent problem of modern combustiology [5].

The main cause of lethal outcomes in patients with extensive thermal injury is a severe generalized infection during the periods of acute burn toxemia (early sepsis) and septicotoxemia (late sepsis), causing multiple-organ failure [6]. Sepsis develops in cases with a large area of deep burns, an acute shortage of donor resources for wound closure, and nosocomial infection associated with contamination of strains of microorganisms multiresistant to antibiotics [7]. In addition to the invasion of aerobic flora in pediatric patients with a lesion area of >40% of the body surface, patients are at a high risk of systemic candidiasis manifested by fungal sepsis [8]. The timing of transporting

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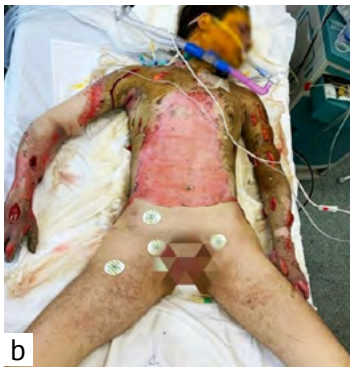

Fig. 1. Anterior (a) and posterior (b) views of the patient.

Fig. 2. Necrectomy with fringing incisions.

a patient with severe burns to a specialized burn hospital and early surgical treatment are essential for the successful treatment and survival of patients [9–12].

Patient M (15 years old) sustained burn injuries on May 3, 2021, following an explosion of unknown chemical reagents. The patient was initially admitted to the Regional Clinical Multidisciplinary Center, and antishock therapy was started. Upon admission, he was diagnosed with thermal inhalation injury, and the clinical presentation of respiratory failure was worsening; therefore, tracheal intubation was performed, followed by artificial lung ventilation. Considering the presence of circular burn wounds on the left upper limb and the trunk, necrotomy of these areas was performed with numerous stripe incisions to decompress soft tissues.

On day 3, the patient was transferred to the burn center of the University Clinic of the Privolzhsky Research Medical University of the Ministry of Health of Russia with a diagnosis of concomitant injury, i.e., degree I–II–III flame burns (according to the International Classification of Diseases, 10th revision) of the head, neck, torso, and upper and lower extremities with a total area of 65% of the body surface (40% indicated degree IIIB according to Vishnevsky's classification); thermal inhalation injury (mild degree); and burn disease in the stage of acute burn toxemia.

On admission, the patient's condition was severe, which was due to the depth and extent of the skin lesion, burn disease in the stage of burn toxemia, and thermal inhalation injury (mild degree according to fibrobronchoscopy). Regarding the level of consciousness, the patient had drug-induced sleep. Artificial lung ventilation through the endotracheal tube was continued. By the evening of May 6, 2021, due to the absence of signs of respiratory failure and preservation of spontaneous breathing, the patient was extubated.

Upon admission to the intensive care unit, complex treatment was continued, which included infusion–transfusion therapy with the use of polyionic, crystalloid, and colloid solutions (albumin and fresh frozen plasma) in a volume of 3500 mL/day, taking into account pathological losses and physiological demand for water, under the control of hourly diuresis and central venous pressure. The following was prescribed:

– Empirical antibiotic therapy with broad-spectrum drugs belonging to glycopeptides (vancomycin) and carbapenems (meropenem).

– Pain relief with opioid non-narcotic analgesics through an infusion pump.

– Anticoagulant therapy (dalteparin sodium) followed by monitoring of the anti-Xa activity of the blood heparin.

– Prevention of erosive and ulcerative changes in the gastrointestinal tract and nutritional support.

– Symptomatic treatment.

Upon admission, the burn wounds had a mosaic nature and were represented by dermal (on the face, anterior surface of the chest on the right, and hands) and subdermal (neck, chin area, back, anterior surface of the chest on the left, and upper limbs) coagulation and colliquative necrosis of gray-brown color, intimately adherent to the underlying tissues. Numerous striped 4–6 cm long incisions were found on the left upper limb and trunk (Fig. 1).

Owing to the persistence of soft tissue edema of the shoulder and forearm, decompression necrofasciotomy was performed on the left upper limb.

On day 9 after the injury, a delayed necrectomy was performed with fringing incisions (Fig. 2) in the area of the upper limbs and trunk affecting 15% of the body surface to the subcutaneous adipose tissue and the deep fascia of the shoulder and chest.

To prevent secondary necrosis, i.e., paranecrosis, to accelerate the reparative processes in the burn wounds, formation of an antibacterial effect, creation of an optimal wound environment, stimulation of the intensive proliferation of cellular elements, and maturation of fine-grained granulation tissue, an antiseptic gel [0.1% undecylenic amidopro-

Fig. 3. Fine-grained granulations before surgery (delayed autodermoplasty).

pyl-betaine and 0.1% polyaminopropyl biguanide (polyhexanide)] was used to treat the postoperative wound. Hydrocolloid coatings were applied on top, which subsequently allowed the use of split autodermal grafts with a high perforation index. The rest of the wounds were dressed with antimicrobial ointment and an aqueous solution of iodine.

Dressings were performed every third day. In the postoperative wounds, paranecroses were formed, mainly in the junction of hydrogel dressings, with an area of approximately 60 cm^2. On day 7 after necrectomy, active growth of fine-grained granulation tissue was noted (Fig. 3).

On the upper limbs, autodermoplasty was performed with a split autodermograft (0.35 mm thick) on 15% of the body surface area.

During the course of intensive therapy, the patient's condition stabilized. The patient was transferred from the intensive care unit to burn unit 2 (children's burn unit) with improvement on day 19, where complex treatment was continued with infusion–transfusion, antibacterial, and anticoagulant therapy, proton pump inhibitors, and symptomatic treatment.

During treatment, antibiotic therapy was adjusted according to the results of the bacterial culture of the wound discharge. The bacterial flora of the burn wounds was represented by multiresistant strains of microorganisms *Klebsiella pneumonia* and *Acinetobacter baumani*. Reserve antibacterial drugs belonging to phosphonic acid derivatives (fosfomycin), polypeptides (polymyxin B), and tetracyclines (tigecycline) were administered.

During planned dressings, staged necrectomy was performed under total intravenous anesthesia. Hydrogel dressings were also applied to exposed wounds. Subsequently, as the wounds were cleansed and the granulation tissue matured, the patient underwent delayed autodermoplasty with a high perforation ratio (1:6). On the chin, neck, and large joints (shoulder and elbow), the perforation index was 1:3. In total, the patient underwent

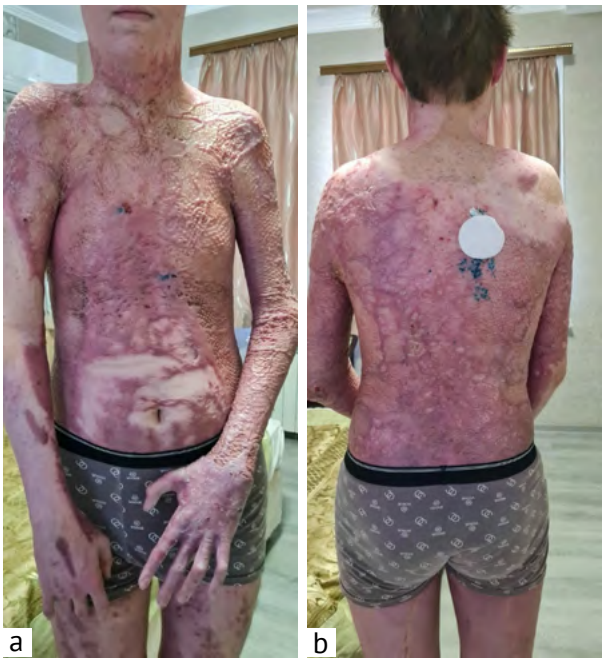

Fig. 4. Treatment outcomes 5 months after the injury: front view (a) and back view (b).

six surgical interventions, with autodermoplasty of 38% of the body surface area.

Donor wounds healed independently under dry dressings, and complete epithelialization occurred on postoperative days 7–10. Taking into account the total area and area of deep thermal lesions, the patient had a deficit of donor sites; therefore, split autodermal grafts were taken again. There was no regression of split autodermal grafts.

The surgical treatment led to the restoration of the skin. The area of residual mosaic wounds that did not require surgical intervention and were epithelialized through independent marginal and insular epithelialization was approximately 1% of the body surface.

On day 54 after the admission, after ultrasonic Doppler examination of the vessels of the lower extremities, verticalization, and activation of the patient were initiated.

The patient stayed in the hospital for a total of 71 bed-days, including 19 days in the intensive care unit. As the disease outcome, the patient was discharged with restored skin (Fig. 4).

Thus, treating patients with severe burn injuries is a difficult task, as it requires special conditions. In this regard, these patients should receive treatment from specialized hospitals for the provision of both surgical and comprehensive intensive care aimed at treating burn disease. The active surgical approach in the treatment of patients with severe burns is a priority, and it decreases patient mortality, significantly reduces the duration of treatment,

and reduces the risk of complications of burn disease (such as sepsis, pneumonia, burn exhaustion, and multiple-organ failure).

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