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Successful treatment of severely burned pediatric patient with comorbid disease burden

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Combustion pathology remains one of the most topical and social important problems of practical public health. A special category of burned patients are children with numerous comorbidities.

Purpose – to present the clinical case of successful management of severe burn victim – the child with numerous birth defects and comorbidities.

Materials and methods. A 7-year-old male patient V. The diagnosis «Third-degree flame burn, 45% of the total body surface area in the regions of upper extremities, buttocks, lower extremities. Mummification of the feet and legs – to the middle third. Inhalation injury. Burn disease. Burn shock, grade IV. Cerebral palsy. Unbalanced chromosome pathology. Statokinetic development delay. Psychomotor development retardation. Hyperhomocysteinemia. Muscle hypotension syndrome. Acute gastritis. Congenital heart disease. Arachnoid cyst. Partial optic nerve atrophy. Concomitant convergent strabismus. Right-sided abdominal cryptorchidism. Aphthous dermatitis. Polyvalent food allergy». The patient underwent early necrectomy-amputation, three necrectomies followed by wound closure with xenoderm grafts, and four skin autografting procedures.

Results. Extremely severe thermal trauma in patients with serious congenital pathology was previously thought by experts to be the injury incompatible with life. In the clinical case presented, the patient's life was saved due to early surgical treatment, which included guillotine amputation-necrectomy of lower extremities aimed at radical debridement to prevent the development of severe burn disease, along with appropriate infusion and pharmacological therapy. Subsequent surgical procedures stabilized the patient's condition, decreased the severity of injury, arrested the progression of burn disease, thus leading to his recovery. By the time of discharge from the hospital (on day 91 post injury), the wounds had completely healed, laboratory parameters were within normal limits.

Conclusions. The prognoses like «the injury is not compatible with life, and treatment is symptomatic» should not be pronounced by clinicians in general and by burn experts in particular. To save the patient's life by all possible means should be the primary goal for all medical professionals.

The research was carried out in accordance with the principles of the Helsinki Declaration. The informed consent of the patient was obtained for conducting the studies.

No conflict of interests was declared by the authors.

Keywords: burns, children, congenital malformations, concomitant pathology, treatment.

Досвід успішного лікування дитини з надкритичними опіками на тлі обтяженого коморбідного стану

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Опіковий травматизм залишається однією з найбільш актуальних і соціально важливих проблем практичної медицини. Особливу категорію обпечених хворих становлять діти з численними супутніми захворюваннями.

Мета – описати клінічний приклад успішного надання допомоги дитині з надкритичними опіками на тлі численних вроджених вад і супутніх захворювань.

Матеріали та методи. *Хворий В.*, віком 7 років. Діагноз «Опік полум'ям III S – 45% у ділянці верхніх кінцівок, сідниць, нижніх кінцівок. Муміфікація ступенів, гомілок до середньої третини. Інгаляційна травма. Опікова хвороба. Опіковий шок IV ст. Дитячий церебральний параліч. Незбалансована хромосомна патологія у вигляді додаткового матеріалу на хромосому 1. Статокінетична затримка розвитку. Затримка психомоторного розвитку. Гіпергомоцистеїнемія. Синдром м'язової гіпотонії. Гострий гастрит. Вроджена вада серця – незакрите овальне вікно, відкритий артеріальний проток. Аномальна хорда. Арахноїдальна кіста. Часткова атрофія зорових нервів. Косоокість збіжна, співдружна. Правобічний черевний крипторхізм. Афтозний дерматит. Полівалентна харчова алергія». Виконано дев'ять хірургічних втручань: ранню некректомію, ампутацію лівої нижньої кінцівки на рівні верхньої третини стегна, правої нижньої кінцівки на рівні гомілки в середній третині за гільйотинним способом, три некректомії із закриттям ран ксенодермоімплантатами та чотири аутодермопластики.

Результати. Вкрай тяжка термічна травма на тлі тяжкості вродженої патології формувала первинну думку спеціалістів, що травма дійсно не сумісна з життям. Хворому вдалося зберегти життя завдяки ранньому хірургічному лікуванню (кінець другої доби після травми) на тлі адекватної інфузійної та фармакологічної терапії, яке передбачало ампутацію-некректомію нижніх кінцівок гільйотинним способом у надзвичайно тяжкому стані за життєвими показаннями з метою радикального видалення маси некротичних тканин, як основного чинника розвитку тяжкості опікової хвороби. Подальші хірургічні втручання стабілізували стан, зменшили тяжкість травми, придушили розвиток опікової хвороби та сприяли одужанню хворого. На момент виписки рани повністю загоїлися, лабораторні показники нормалізувалися. На 91-шу добу після травми хворий виписаний додому.

Висновки. У медицині взагалі, у комбустіології зокрема, не слід робити передчасних прогнозів зразка «травма не сумісна з життям, лікування симптоматичне». За життя кожного пацієнта медичні працівники повинні боротися всіма можливими способами до останнього подиху хворого.

Дослідження виконано відповідно до принципів Гельсінської декларації. На проведення досліджень отримано інформовану згоду батьків дитини.

Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: опіки, діти, вроджені вади, супутня патологія, лікування.

Introduction

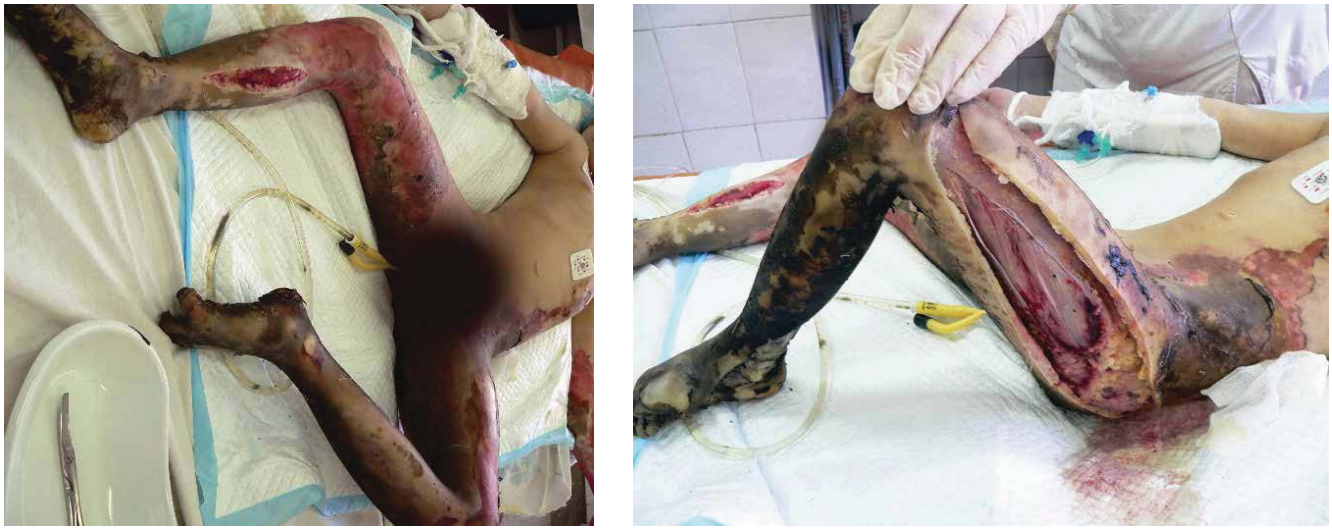
Burn-related injuries, especially major burns causing massive tissue destruction, still remain a great challenge for medical community globally with morbidity and mortality being consistently high or tend to increase [5,8,15]. Nowadays, in the period of COVID-19 pandemic, which has upended everyday life of people, decreased incidence of burn cases, is registered [12]. At the same time, the number of burn victims requiring intensive care therapy is still high [18]. Burn injuries in pediatric population are known to be rather common accounting for an estimated 13.8 to 75.3% of the total number of hospitalizations for thermal trauma. Multisystemic pathophysiological effects of burn injury on virtually every organ system are often accompanied by strong emotional distress that can lead to persistent mental disorders in future life [3,4,10,]. Although boiling water is considered to be the major etiological factor of thermal injuries in children, it is flame burns that are responsible for long-term treatment, development of various complications, sometimes fatal ones, and long rehabilitation period. According to the WHO, fire-related thermal injuries are 11th among causes of death in children aged 1 to 9 years [17]. This refers especially to low-income nations where child mortality rate is ten times as high as in the developed countries [14]. The main reason for that is lack of education and access to medical care as well as poor parents' awareness regarding burn injuries and low socio-economic status in families, resulting in unsatisfactory conditions for child care [9]. Besides, child neglect and abuse should be taken into consideration, being responsible for about 10% of severe burns among all burn accidents in those countries [13,16].

Introduction of modern principles and methods in management of pediatric patients with severe deep thermal injuries into clinical practice has improved the survival rate, offering new challenges to medical professionals [1]. Successful burn injury management in children demands a number of staged surgeries to be performed, and according to some authors, over 40% of burn victims require reconstructive operations [19]. Besides, pediatric patients require special considerations because of peculiarities in their anatomy and physiology which influence not only the burn wound healing processes but also the changes in the body as a whole [2,7]. It should be noted, that no current literature describes cases of thermal trauma and the course of burn disease in children with congenital malformations. Cerebral palsy is one of them, its incidence in the world being quite stable – 2–3 cases per 1000 births [20]. Thus, lack of studies and published data devoted to the management of severe burns in children with cerebral palsy as well as other genetic disorders, motivated the authors to write this article.

Purpose of the work – to present the clinical case of successful management of severe burn victim – the child with numerous birth defects and comorbidities.

Materials and methods

A 7-year-old male patient V., inpatient medical card No. 6832, was admitted to the Clinical Center for Thermal



a *b*

Fig. 1. Making necrotomy incisions on the patient's right leg (a) and left thigh (b)

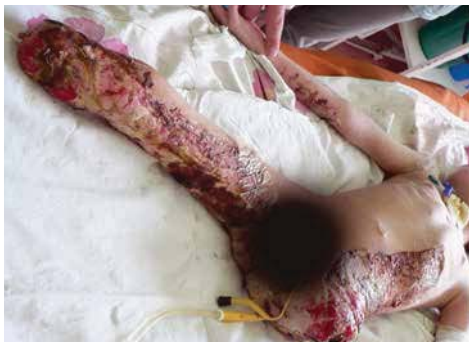


Fig. 2. The wounds after guillotine amputation of extremities, necrectomy and xenoplasty

Fig. 3. Staged closure of granulating wounds with free perforated skin grafts

Fig. 4. Final closure of granulating wounds with free perforated skin grafts

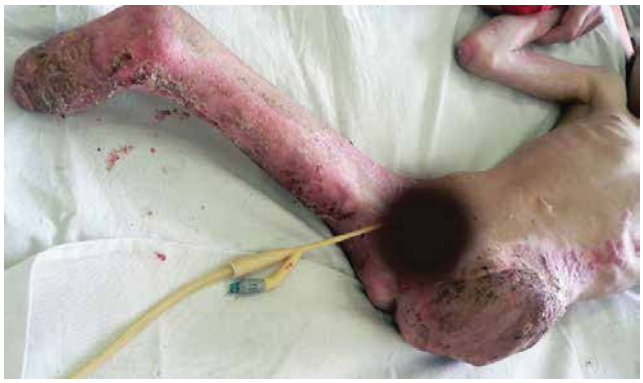


Fig. 5. The patient before discharge from the hospital

Injury and Plastic Surgery of Municipal Non-profit Enterprise «Vinnytsia Regional Clinical Hospital Vinnytsia Regional Council» on June 14, 2021 with the diagnosis: Third-degree burns by flame, involving 45% of the body surface in the regions of upper extremities, buttocks, lower extremities. Mummification of feet, legs – to the middle third. Inhalation injury. ISS (injury severity score) – 180 U. Burn disease, grade IV burn shock. Congenital pathology: Cerebral palsy. Unbalanced chromosomal pathology – extra genetic material on chromosome 1. Statokinetic developmental delay. Psychomotor development retardation (PDR). Hyperhomocysteinemia. Muscle hypotension syndrome. Acute gastritis. Congenital heart defects – patent foramen ovale, patent ductus arteriosus. Anomalous chord. Arachnoid cyst. Partial atrophy of optic nerves. Concomitant convergent strabismus. Right-sided abdominal cryptorchidism. Aphthous dermatitis. Polyvalent food allergy.

The research was carried out in accordance with the principles of the Helsinki Declaration. The informed consent of the patient was obtained for conducting the studies.

According to present history data, the child had sustained burn injury by open flame in his household on June 13, 2021 about 1 p. m. as a result of inappropriate use of low quality electric device (hair dryer) for heating the room. At the time of accident the child was left alone and, because of serious physical and mental disability, he could neither leave the house himself nor call for help. Because of such circumstances, the exact time of exposure to a flame source was not able to be established. After the parents had

noticed the flame, they evacuated the boy from the house and called an ambulance. The victim was soon transported to the district hospital and admitted to Intensive Care Unit. After the boy had been evaluated, multicomponent infusion therapy was initiated. The burn specialist was sent for to determine the depth and size of the burns and to make definitive clinical diagnosis. The patient necessitated urgent necrotomy which was performed in the area of the right leg, left thigh followed by exploration of muscles. The right leg was found to have superficial damage, while the muscles of the left thigh showed no response to stimuli; deep necrosis was detected with no signs of bleeding (Fig. 1).

Post-necrotomy wounds were covered with gauze pads soaked in 3% hydrogen peroxide solution. 2.5% povidone-iodine pads were used to close other damaged regions. In addition, quantity of fluids calculated by Carvajal's formula, composition of infusion-transfusion therapy as well as agents for pharmacological support (analgesics, cardiovascular drugs, anticoagulants, antiplatelet medications, proteolysis inhibitors, membrane protectors, hepatoprotective drugs, antihypoxic drugs, antioxidants, antibiotics) were adjusted. In perioperative period (before surgery and for the first 18 hours post operation) the patient received respiratory support preserving independent breathing (delivery of heated humidified oxygen-air mixture through nasal cannula system with correction of FiO_2 to 21% in dynamics). Early necrotomy performed under general anesthesia was followed by balanced parenteral therapy in combination with early enteral nutrition according to the patient's daily needs [6,11]. The following day, after hemodynamic parameters had been stabilized, a collegial decision was made to transport the patient to the regional burn center in order to provide specialized medical care.

Subsequent evaluation of the patient included visual assessment of general condition and the injured areas, as well as general laboratory and biochemical blood tests, urine analysis, wound microbiology. Besides, the following instrumental studies were performed: thermometry, monitoring of basic vital signs (heart rate (HR), respiratory rate (RR), blood pressure (BP), oxygen saturation (SaO_2)).

Clinical management strategy included multicomponent infusion-transfusion and drug therapy, early surgical removal of necrotic tissue under general anesthesia followed by wounds closure with lyophilized xenoderm grafts (LLC «Institute of Biomedical Technologies», Ternopil, Ukraine) and restoration of skin integrity with free perforated autodermal grafts.

Results

On admission the child's condition was extremely severe: heart rate – 140 bpm, rhythmic, blood pressure – 60/30 mm Hg, RR – 20/min, daily diuresis – 1000 ml. Hematologic findings were the following: erythrocytes – 4.41×1012/l, hemoglobin (Hb) – 104 g/l, leukocytes – 41.6×109/l with leucocyte left shift (rods – 23%, segments – 48%, lymphocytes – 21%, monocytes – 8%, platelets – 628×109//l), erythrocyte sedimentation rate (ESR) – 23 mm/h, blood sugar – 6.7 mmol/l, K – 4.74 mmol/l, Na – 131.0 mmol/l, Cl – 101.4 mmol/l, total protein – 43.0 g/l, total bilirubin – 35.0 μmol/l (direct – 8.0 μmol/l, indirect – 27.0 μmol/l), urea – 15.5 mmol/l, creatinine – 96.0 μmol/l. General analysis of urine: color – pale yellow, transparency – turbid, specific gravity – 1030, reaction – sour, protein – 0.099, sugar – absent, squamous epithelial cells – 5–6 per power field, leukocytes – 25–30 per power field, erythrocytes – 2–3 per power field, oxalates – in moderate amount.

Having received the mother's consent, the decision to perform life-saving surgery was made by multidisciplinary case management team at the end of the second day post injury. Approximate extent of surgical intervention was the following: guillotine amputation of lower extremities, partial dermatome necrectomy followed by the closure of postoperative wounds with lyophilized xenoderm grafts. On June 15, 2021, the following surgical procedures were performed: amputation of the left lower extremity at the level of upper third of the thigh, midleg amputation of the right lower extremity, partial dermatome necrectomy, xenoplasty (Fig. 2).

The postoperative course was unremarkable, the patient's condition remained critical, but stable. Hemodynamic parameters improved, blood pressure increased to 110/70 mm Hg. Given the positive dynamics, on June 16, 2021, the patient underwent reoperation for complete devitalized tissue removal – early dermatome necrectomy and xenoplasty. Subsequently, amputee management included continuous multimodality infusion-transfusion and drug support, daily dressings using antiseptic solutions. On day 33 post injury, on July 16, 2021, the staged closure of granulating wounds with free perforated autodermal grafts was initiated (Fig. 3).

Each subsequent surgical closure of granulating wounds with free perforated autodermal grafts was associated with dynamic improvement of the child's condition. Thus, four skin grafting procedures carried out during the period of 52 days, resulted in complete closure of granulating wounds (Fig. 4).

On day 91post injury, on September 15, 2021, the patient was discharged from the hospital with completely healed wounds (Fig. 5).

At this stage of burn injury management, objective examination data, laboratory findings as well as the results of instrumental studies were found to be within normal limits.

Conclusions

Management of pediatric patient with extremely critical burns was successful due to early (the second day post injury) radical surgical treatment which included guillotine amputation of lower extremities with partial dermatome necrectomy to remove the mass of necrotic tissue as the major factor in development of complications, along with adequate intensive therapy (respiratory, infusion-transfusion) and pharmacological support.

Saving the life of severe burn victim – the child with serious congenital anomalies – in the case presented, denies grave prognoses previously given for such patients, as well as the statements like: «The injury is not compatible with life, and treatment could be only symptomatic». The authors believe that keeping the patient alive by all possible means, irrespective of disease severity, should be the primary goal for all medical professionals.

No conflict of interests was declared by the authors.

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