LIFE-THREATENING BURNS CAUSED BY HOUSEHOLD CHEMICALS

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BACKGROUND Chemical burns are 2.5 % to 5.1% of all burn injuries. Burns caused with household chemicals occur even more rarely. Because of its relative rarity there is no common surgical tactics for such patients. This type of burn trauma still remains under discussion.

AIM OF STUDY Optimization of surgical treatment tactics in patients with severe chemical burns caused by household chemicals.

MATERIAL AND METHODS Medical histories of patients with life-threatening burns, caused by household chemicals.

RESULTS In order to remove the damaging agent, multiple incisions were performed as early as possible after admission. After stabilization, necrotized tissue was removed gradually to the superficial fascia. Single-stage autografting was considered unreasonable due to the lack of objective factors of the lesion depth. Hydrocolloid dressings were used for temporal closure of wounds. As tissues became clean we covered granulating wound by split-skin grafts.

CONCLUSION Early fascial excision and delayed autoplasty is the priority method of surgical treatment of patients with life-threatening burns caused by household chemicals.

Keywords: chemical burns, surgery, autoplasty

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INTRODUCTION

Chemical burns occur much less often than thermal or electrical burns, and according to different authors make 2.5 to 5.1% of cases of burn injuries [1]. The chemicals continue to irreversibly damage the tissues until being inactivated by neutralization and dilution. Therefore, the depth and extent of skin lesions during chemical exposure are usually much larger than it seems during the initial examination, and the necrosis zone can grow in dynamics, especially if the damaging substance was not neutralized on time [2]. Even limited chemical burns can often lead to severe impairment of function and gross cosmetic defects, and in some cases are life-threatening [3].

The literature describes four factors that determine the severity of damage by a chemical substance: the strength of the agent (the intensity of interaction of the substance with living tissues), its amount (depends on volume and concentration), the degree of penetration (depends on the ability of tissues to neutralize the agent) and the mechanism of action due to method of protein denaturation [4]. Among the whole range of household chemicals there is a group of substances in which the above factors are most pronounced. These agents are designed to clean water pipes, and their active substances are concentrated solutions of "strong" alkalis (sodium hydroxide and potassium hydroxide). These chemical compounds are capable of deep penetration into tissues and cause almost instantaneous coagulation of all cellular structures of the skin.

Surgical treatment of chemical burns should begin with necrotomy performed within the next few hours after the arrival of victims [5, 6]. In the literature sources there are data that the most reasonable tactic is the earlier excision of the formed crust with the temporary closure of the defects formed by modern wound coverings and delayed autodermoplasty [7].

Purpose of the study. To optimize the tactics of surgical treatment of victims with extensive chemical burns household chemicals.

STUDY MATERIAL

Histories of patients with cleaning agents chemical burns of more than 20% of the body surfac, hospitalized in the Saint-Petersburg Research Institute of Emergency Medicine n.a. I.I. Dzhanelidze from January 2015 to December 2016.

Results of the study and discussion. In 2015-2016, 4 injured with this type of injury were hospitalized in the department of burn resuscitation. The cause of burns in all patients was cleaning products containing concentrated alkali solutions. Clinical observations are given below.

Victim B., 37 years old, was found by relatives in a state of intoxicated sleeping on the floor in a pool of "Krot" pipe cleaning fluid. The time of exposure was unknown, nobody washed the agent off the burnt surfaces with water. Burn wounds had mottled dermis with the formation of dry dense eschar (Fig. 1). Diagnosis: Burn disease. Chemical burn (alkali) 36% (29%) / IIIa, b-IV degree of the trunk, lower extremities, external genital organs. Shock of II stage. Chemical burn of the esophagus. After washing the wounds with running water, he was hospitalized in the department of burn resuscitation, positioned on the fluidized bed. Necrotomy and fasciotomy were performed 2 hours after admission. On the second day, necrosectomy of 12% of the body surface (buttocks and left thigh) was performed on an area of with electric scalpel. After reaching the hemostasis, the wounds were temporarily closed with a hydrocolloid wound cover. The next necrosectomy of 6% of the body surface (right thigh) was performed on the 5th day. The remaining sections of the crust were removed on a phased basis during daily dressings. Restoration of the skin was performed sequentaly by perforated split autografts on the 14th (free autodermoplasty (FADP) 9% of the body surface), 20th (FADP 10% b.s.) and 26th day (FADP 6,5% b.s.) from the moment of injury. On the 49th day, after epithelialization of donor wounds and

transplanted skin grafts, the patient was transferred to a surgical department for the treatment of stenosis of the esophagus, which developed as a result of a chemical burn.

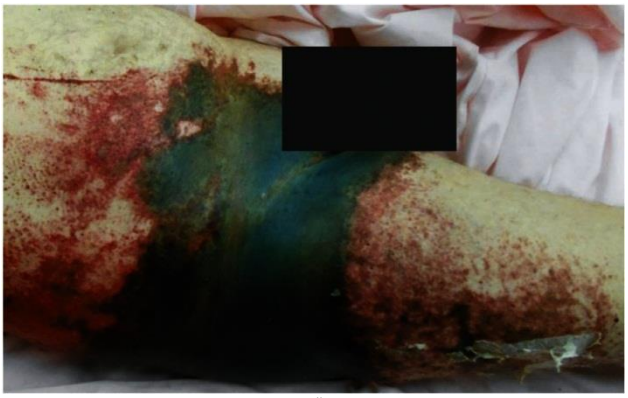

Fig. 1. Victim B. Chemical burns with "Krot" pipe cleaning fluid, prolonged exposure (the wound at the moment of hospitalization)

Victim M., 33 years old. In the course of the family conflict, she was bathed by her husband with "Krot" cleaning pipe fluid. The time of exposure of about 20 minutes, washing of wounds with water at the prehospital stage was not performed. Upon arrival, burns had moist gray-brown eschar with a pattern of thrombosed vessels (Fig. 2). Diagnosis: Burn disease. Chemical burn (alkali) 61% (45%) / IIIa, b-IV stage of the head, neck, trunk, extremities. Shock stage III. Chemical eye burn II-III stage. After the wounds cleaning, the patient was hospitalized in an extremely serious condition in the department of burn resuscitation, positioned on a fluidizing support. In connection with the severity of the condition and the instability of hemodynamics, it was decided to refrain from early surgical treatment, and noninvasive therapeutic approach was recommended. In the course of anti-shock therapy, the temporary stabilization of vital functions was achieved. However, on the 6th day, leukocytes and platelets increased (leukocytes 2.7 · 10^{9}/L, platelets 48 · 10^{9}/L) and renal insufficiency progressed (blood creatinine 619 μmol/L), which together with hypothermia 33-34° C and positive blood culture (A. Baumannii) was regarded as signs of burn sepsis. The patient died on the 10th day of progressive multi-organ dysfunction.

Fig. 2. Victim M. Burns with "Krot" pipe cleaning fluid, short exposure (the wound at the moment of hospitalization)

Victim N., 55 years old. He was diluting caustic soda with water while preparing a detergent. As a result of the explosion he fell on the floor into a pool of spilled liquid. Immediately after that he took a shower and called for an ambulance. Upon arrival, the wound had a de-epithelialized white derma with areas of dense eschar of gray-green and black color (Fig. 3). Diagnosis on admission: Burn disease. Chemical burn (alkali) 26% (12%) / II-IIIa, b stage of the head, neck, trunk, upper limbs. Shock stage I. He was hospitalized in the department of burn resuscitation, after necrotomy he was placed on a fluidized bed. On the 4th day, necrectomy was performed in the gluteal region and the posterior surface of the right thigh to the level of fatty tissue (8% of the lat.). Formed wounds were covered with hydrocolloid wound covers. As the remaining eschar sloughed gradually, repeated necrectomies were performed. The skin was restored by a single intervention (FADP 11% b.s.), performed on the 27th day from the moment of injury. The engraftment of transplanted tissues was about 90%, the epithelialization of donor wounds itself was observed. By the 50th day, the victim was transferred to outpatient treatment at his place of residence.

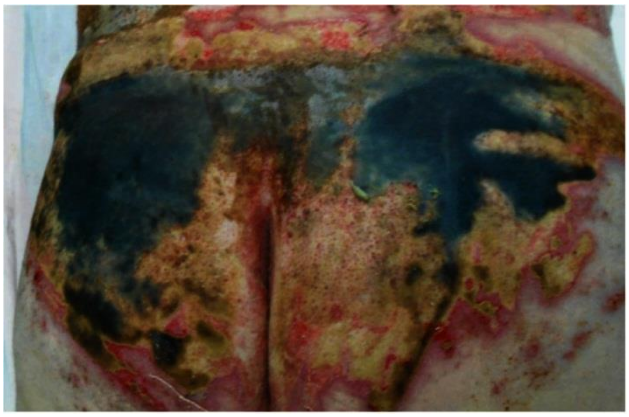

Fig. 3. Victim N. Chemical burns of the gluteal region with caustic soda (the wound at the moment of hospitalization)

Victim Z, 56 years old. While drinking alcoholic beverages, she was beaten up by her cohabitor and bathed with "Stock Master" pipe cleaner. The exposure was about 2 hours, the wounds were not washed with water. Upon arrival, burns had a wet eschar of light brown to gray color (Fig. 4). Diagnosis: Burn disease. Chemical burn (alkali) 60% (37%) / II-IIIa, b-IV stage of the head, neck, trunk, upper and lower extremities. Shock stage III. After washing the burn wounds and making multiple necrotomic incisions, the patient was hospitalized in the department of burn resuscitation and positioned on a fluidized bed.

Fig. 4. Victim Z. Burns with "Stock Master" pipe cleaner (the wound at the moment of hospitalization)

On the 2nd day, the necrectomy of 7% b.s. was performed on the right thigh with a scalpel and electric knife. The bottom of the wound had areas of the superficial fascia of doubtful viability. After achieving stable hemostasis and lining the edges of the wound, the formed defect was temporarily closed with hydrocolloid coatings. Further excision of non-viable tissues was performed by the same method on the 8th (10% b.s.), 11th (6% b.s.) and 14th day (12% b.s.). After the final cleaning of the wounds and the formation of granulations, various versions of economical cutaneous plastics were used. In total, this victim required 10 autotransplantations on an area from 1.5 to 9% of b.s., which were performed from 21st to 127th day. In connection with the partial lysis of donor wounds and a high plastic factor (1:4), the culture of allogeneic fibroblasts was transplanted three times to stimulate repair processes (Fig. 5). The victim was discharged on the 156th day with completely restored skin and formed scar deformities.

Fig. 5. Victim Z. Application of gel with allogeneic fibroblasts for stimulation of reparative processes in the burn wound

In the presented observations, surgical treatment of the victims was aimed at the prevention and treatment of wound infection by removing devitalized tissues as soon as possible. To do this, immediately after washing the burn

wounds with running water, dissection of the areas of deep damage of the skin was performed. In this case, necrotomic incisions were made not only for decompression of the distal parts of the limbs, but also for providing free outflow of wound detachable containing aggressive chemical substances.

After stabilization of the condition and restoration of peripheral microcirculation, it became possible to perform early necrectomy. Given the propensity of alkalis to spread deep into and along the soft tissue [8], tangential necrosis was considered insufficiently effective in this category of victims. Proceeding from this, when choosing the method of surgical treatment, we preferred the so-called "fringing" necrectomy. The excision technique consisted of the following: the working part of the Söring MBC-601 electro-surgical device was applied along the edge of intact tissues with bordering cuts to a depth of 2-4 mm. Further separation of the burned eschar from the underlying tissues was performed bluntly by a single block up to the fascia or in the thickness of fatty tissue. Then, to reduce the size of the formed wound defect and reduce the risk of bleeding, the perimeter of the wound was covered with a resorbable suture.

Considering the large area of damage to the skin in the reported observations, one-stage excision of the entire volume of devitalized tissues was difficult, which required a step-by-step approach to surgical treatment. In this regard, during the first necrectomy we tried to remove most of the eschar, but not more than 15% of the b.s. [9, 10]. The volume of one-stage excision of the eschar was determined by the severity of the condition in a patient and the area of deliberately deep lesion of the skin. In this case, excision began from the extremities, where the volume of blood loss can be reduced with the help of a tourniquet, elevated position and tight bandaging. Further removal of the remaining eschar (5-10% of b.s) was carried out with an interval of 1-3 days.

Due to the lack of clear visual criteria for the depth of the lesion in chemical burns, it was considered unreasonable to perform one-step autoplasty. After reaching the hemostasis, the soft tissue defect was temporarily closed with hydrocolloid wound coverings. Maintaining their own moist environment and the necessary temperature balance, on the one hand, cleared the wounds from the remaining areas of necrosis and increased the rate of granulation tissue formation, and on the other hand prevented the drying out of wounds and the formation of secondary necrosis. After the swelling of the hydrocolloid gel (1-3 days depending on the intensity of exudation), the wound cover was changed. As the wounds were cleared and granulation tissue was formed (7-10 days after necrectomy), free autodermoplasty was performed with split (0.3-0.4 mm) perforated autografts.

CONCLUSION

Household chemical products based on concentrated alkali solutions are a potential threat to life and health in violation of safety regulations. The circumstances of getting burned by these substances are usually connected either with alcoholic intoxication, or with violent actions [11]. Development of life-threatening burns is facilitated by the horizontal position of the injured body, prolonged exposure of the chemical substance and the refusal to wash the wounds with running water at the prehospital stage. The wet eschar and the predominant location of the lesion along the posterior surface of the trunk and extremities require the positioning of the affected on the fluidizing support for the entire treatment period, up to the period of convalescence.

FINDINGS

1. In the victims with life-threatening burns household chemicals, early surgical intervention allows to achieve acceptable treatment results.

2. The application of multiple necrotomy cuts in this category of patients contributes not only to the prevention of local hypertensive-ischemic syndrome, but also to a decrease in the concentration of the chemical agent in the injury zone, that is, it prevents the deepening of burn wounds.

3. Given the depth of penetration of aggressive substances into soft tissues, the tangential excision of the eschar in these patients should be considered insufficiently effective. In this regard, during surgical treatment, we recommend seeking to remove the whole part of damaged tissue to the level of the superficial fascia. At the same time, the optimal time for performing the operation is the first 7 days from the moment of injury.

4. Simultaneous restoration of the skin with chemical burns entails a significant risk of loss of grafts, which can be reduced by performing delayed autodermoplasty as the granulation tissue is formed.

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