

NEW TECHNOLOGIES FOR TREATMENT OF HAND AND FOOT BURNS IN AN ARTIFICIALLY CREATED MOIST ENVIRONMENT

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Abstract

Treatment of patients with deep burns of the hand and foot continues to be one of the important tasks of surgery due to the functional significance of the limb segment in question, since after plastic closure of the lost skin and spontaneous healing of part of the burn surface, deformities and contractures of the hand and foot appear. This study analyzed outcomes for 128 patients with severe burns of the hand and foot. The patients were divided into two groups: Group 1 (n = 68). Silver-containing preparations were applied to the burn areas, and then the hand and foot were placed into a polyethylene packet secured with a bandage. After placing the hand and foot into the polyethylene packet, hotbed effect developed inside. Group 2 (n = 60 patients) who were treated traditionally. The first group surgery was usually performed 16–18 days after burn, with a non-perforated skin graft. The complication was performed on 5 (7.4%) of the patients because the transplanted skin lysed in some places. As a rule, the term of skin-covering rehabilitation coincided with the patients' discharge from the hospital and our observation of 23.5±1,0 days. The second group allowed periods of time (22–24 days) to recover the skin cover. The second operation was performed on 9 (15.0%) of the patients with autograft. Patients remained in hospital on average for 32.5 ± 2.1 days. The procedures helped shorten their hospital stay, reduce expenses, and lessen joint and contracture deformities.

Keywords: Burns; Moist environment; Hand; Foot; Treatment

INTRODUCTION

Burn injuries and their treatments were first described in 1500 BC [1]. Advances have been made over the centuries from early treatments involving resin and honey. However, great strides have been made more recently in the twentieth century as a result of improved fluid management, surgical and medical technology [2]. Burn injury incidence is common worldwide and considered a major global public health crisis. Burn recovery is unique, complex, and dynamic, and psychosocial recovery is just as important as physical recovery [3, 4]. The epidemiology of hand and foot burns was previously reported in the literature and an incidence of such injuries per annum was documented [5, 6]. The International Society for Burn Injuries (ISBI) acknowledges hand and foot burns as serious injuries even though they do not directly impact mortality [7, 8]. Hands and feet account for less than 5% of the total body surface area (TBSA), but the loss of their functionality has a significant impact on the body's total functional impairment [9, 10]. Treatment of patients with deep burns of the hand and foot continues to be one of the important tasks of modern burn surgery due to the functional significance of the limb segment in question, since after plastic closure of the lost skin and spontaneous healing of part of the burn surface in 18 to 43% of burn convalescents, deformities and contractures of the hand and foot appear [11, 12]. Hand and foot burns frequently occur either as components of extensive burns or as isolated injuries and can cause significant functional impairment. Summing up the above-mentioned reasons, the investigation into rational methods of treatment of deep hand and foot burns is of great importance today. Patients with deep hand and foot burns require immediate hospital admission, special treatment, and fast preparation of the injured site for skin grafting. Many controlled studies confirmed that wounds heal more readily in a moist, physiological environment. Maintenance of a moist wound environment facilitates the wound-healing process. By contrast, prevention of dehydration results in a marked delay in the healing of partial-thickness burn wounds. Our research aims to study and analyse peculiarities of the course of the hand and foot burn wounds in the condition of an artificial moist medium.

METHODS

Ethics statement: This study received approval from Samarkand Centre of Emergency 61 Medical Care (RCSUMA) and Inter-Regional Burn Centre, Samarkand, Uzbekistan. The 62 parents of children provided their written informed consent to participate in this study. Between 2015 and 2022 were treated 128 with severe burns of the hand and foot to the Burn Department of the Centre of Emergency Medical Care, Samarkand, Uzbekistan. Of these, 31.2% (n - 40) of the patients were younger than 1 year, 14.1% (n - 18) of the patients were between 1 and 6 years of age, 9.4% (n - 12) were between 7 and 14 years of age, 12.5% (n - 16) were between 15 and 19 years of age, 14.1% (n - 18) were between 20-44 years of age, 14.1% (n - 18) were between 45-59 years of age, and 4.6% (n - 6) were between 60 and 81 years of age. 75 of the patients were male and 53 female (Table 1).

Table 1. Distribution of patients by age group. Fisher Exact test did not show any statistically significant difference between groups.

Age	Male	Female	Total %
<1 year	26	14	40 (31,2%)
1<6 years	13	5	18 (14,1%)
7<14 years	8	4	12 (9,4%)
15<19 years	5	11	16 (12,5%)
20<44 years	9	9	18 (14,1%)
45<59 years	11	7	18 (14,1%)
60 - 81 years	3	3	6 (4,6%)
TOTAL	75 (58,6%)	53 (41,4%)	128 (100%)

The causes of burns were: sandal burns – 37 (28.9%), flame – 32 (25.0 %), contact burns (ash, asphalt, electrical burns) – 34 (26.6 %), and others – 25 (19.5 %) (Table2).

Table 2. The distribution of patients by different kinds of burns. Fisher's exact test did not show any statistically significant difference between groups.

	Kind of burns		%
1	Sandal burns	37	28.9
2	Flame	32	25.0
3	Contact burns (ash, asphalt)	34	26.6
3	Other burns	25	19.5
	Total	128	100

Most burns were classified as sandal burns, i.e. 37 (28.9%). However, children, especially toddlers, when left unsupervised, can crawl under the blanket and fall with hand and foot into the coals. In the case of sandal burns of hand, it usually is not only skin that is injured but also underlying tissues: subcutaneous fat, fasciae, muscles, and even bones. The distribution of patients depending on the location of the burn and the nature of the depth of damage is shown in Table 3. **Table 3. The distribution of patients according to the depth of burn trauma and its localization**

Burn localization	Deep burs	Total (%)
Hand	37	(28, 9%)
Foot	66	(51, 6%)
Hand + Foot	25	(19, 5%)
Total	128	(100%)

All patients were given antibiotics on the day of presentation. Ceftriaxone was the commonest antibiotic used followed by co-amoxiclav all combined with metronidazole or tinidazole, prednisolone and molecular blood substitutes. The patients were divided into two groups:

The first group (main) included 68 patients, after performing debridement of the burn wounds of the hand and foot, silver-containing preparations (2% - argosulfan, 1% - dermazin), was applied on the burn areas and then the hand and foot was placed into a polyethylene packet fixed by a bandage, after placing the hand and foot into the polyethylene packet, hotbed effect developed inside. One and two hour after beginning the treatment, moisture began to condense on the inner surface of the packet and its amount gradually increased. Water evaporation outflow took place most during the first 48 hours after burn trauma, on average from 400 ml to 800 ml. In the following days, the amount of liquid outflow decreased. Discharge of liquid through the injured surface discontinued fully 7–10 days after burn trauma. After the plasma leakage through the wound surfaces had stopped and were performed using solution betadine or levomecol ointment. Our observations showed that the dressings were painless the separation of eschar from the wounds took place rapidly and painlessly for the patient, as a rule. After excision of eschar, we used a non-perforated skin graft, 0.2–0.3 mm on granulation tissue. The granulation tissue wound surface, must be is bright pink, neat, juicy, with little bleeding, without oedema and with minimal microflora. Surgery was performed 16–18 days after burn trauma. The first bandage was removed on the second or third day after surgery. If the skin engrafted well, we proceeded with physical therapy and remedial gymnastics after about the sixth day. After that, the patients were discharged from the hospital for outpatient treatment. To prevent or reduce edema we used elevation, passive mobilization, retrograde massage, and bandages.

Second group (control) this included 60 patients who were treated in the traditional manner. The following surgical procedures were performed on the patients: necrotomy was performed to prevent secondary necrosis and to accelerate the rejection of necrotic tissue. After necrotomy, the wound was covered with chemotherapeutic materials (trypsin and chemotrypsin) for that accelerated the removal of the necrotic tissue. The next step was a staged surgical necrectomy. In patients, full excision was performed 13–16 days after burn. The wounds were ready for autografting 23–25 days after the burn trauma by applying a non-perforated and perforated skin graft, 0.2–0.3 mm thick. Grafts from the external and internal surfaces of the hip were normally used. The first bandage was removed on the second or fourth day after surgery. Physical therapy and splinting should be started immediately after the injury.

RESULTS

The quality of results treatment in patients of the main and comparison groups was assessed by the following clinical indicators: time of complete cleansing of wounds from necrotic tissue residues, time of formation of optimal granulation cover, time of the first autodermoplasty operation, percentage of engraftment of autografts, time of restoration of the skin cover and total time of inpatient treatment.

First group (main): after placing the hand and foot into the packet, the so-called 'hotbed effect' developed inside (68 patients), prevented the development complication and hardening of patients' state – and allowed the short period of time (16–18 days) to recover viable skin coverage. Autografts result not only in the uncovering of already closed wounds but also in extension of the injured surface due to donor areas. The second operation was performed on 5 (7.4%) of the patients (2 of hand and 3 of foot) because the transplanted skin lysed in some places. Complete rehabilitation of skin covering provided engraftment

of transplants, donor injuries and epithelisation of superficial burns. As a rule, the term of skin-covering rehabilitation coincided with the patients' discharge from the hospital and our observation of 23.5 ± 1.0 days.

Second group (control): those who were treated in the traditional manner (60 patients) were allowed periods of time (23–25 days) to recover the skin cover. The second operation was performed on 9 (15.0%) of the patients (5 of hand and 4 of foot) autograft. Patients remained in hospital on average for 32.5 ± 2.1 days.

The analysis of the latest results from the first group (up to 2 years) showed that 8 (11.8%) out of 68 patients (5 of hand and 3 of foot) came back to the hospital for revision surgery because of the loss of ability to move their extremities normally. The second group showed that 19 (31.7%) out of 60 patients (8 of hand and 11 of foot) came back for revision surgery because of growth and retraction of graft and foot contractures of II–III degrees (Table 4).

Таблица 4. Analysis of treatment results of patients of hand and foot burns.

№	Results	I группа (n=68)	II группа (n=60)
1	Operation term	16-18 days	23-25 days
2	Bed day	23.5 ± 1.0	32.5 ± 2.1
3	Second autodermoplastic surgery	5 (7.4%)	9 (15.0%)
4	Complications in the nearest after operation period	8 (11.9%)	19 (31.7%)

DISCUSSION

Hand and foot burns have a complication and prolonged hospital stay. Although isolated hand and foot burns represent a small body surface area, over half require treatment as inpatients to allow for initial aggressive conservative management of elevation and regular wound cleansing to avoid complications [13]. This study suggests a treatment for the initial acute management of hand and foot burns. This immediate referral of all hand and foot burns to a burn department, admission of these burns, bandages, treatment of hand and foot in a humid environment for the purpose of early wound preparation for autodermoplasty and prophylactic antibiotics [14, 15]. In Uzbekistan, sandal burns is very common in winter time are of special interest. Most of the patients with sandal burns have foot and hand. Characteristics of sandal burns include not only injuries to skin but also injuries to the underlying tissues [16-18]. The investigation into rational methods of treatment of deep hand and foot burns is of great importance today. There is no dilemma in the case of deep burns; the only treatment method is surgery. Patients with deep hand and foot burns require immediate hospital admission, treatment and early preparation of the injured site for skin grafting. [19,20]. Skin grafting usually performed immediately after burn excision or in a subsequent procedure (necrotomy, necrectomy and autografting). A conservative approach treats burns by applying dressings until eschar separates. The granulated tissue underneath the eschar is then covered with split thickness skin graft. Delaying surgery can be advantageous as it differentiates areas that can heal without surgery from those that require grafting [22-24]. The main surgical intervention for the treatment of deep hand and foot burns is tangential excision followed by skin grafting [25]. Alternatively, eschar excision performed before natural separation of the eschar has been considered as early excision, while eschar removed after natural separation has been referred to as delayed excision [26]. Postponing excision of deep partial-thickness burns could allow infection. Summing up the above-mentioned reasons, methods of treatment of deep hand and foot burns are of great importance today. Patients with deep hand and foot burns require special treatment and fast preparation of the injured site for skin grafting. During many years the tactics of thermal injuries management under dry eschar was used, however the results of contemporary investigations confirm the increase of efficacy of burn reparation in the conditions of moist medium. Management of burn wounds in a humid environment is one of the most promising methods of conservative treatment of burns, allowing to achieve early prepare the wound for autodermoplasty and decreased of post-burn complications. In the burn patients, the therapeutic exercise program including passive, active, and active-

assisted exercises increased muscular strength and prevented atrophy. Coordination exercises and isometric and strengthening exercises during this period helped to improve the patient's functional status. Individual patient-specific functional activities added to the treatment program were applied to all patients for self-care, work and productive activities and leisure time activities, helping patients to continue their roles and routines independently.

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