

Çocuklarda Yanık; 145 Hasta ile Güncellenen Veriler

Burns in Children: Data Update with 145 Patients

Mustafa Alper Akay¹, Murat Güven², Hayrünisa Kahraman Esen³, Osman Esen⁴, Zekeriya İlçe⁵

1 Kocaeli Üniversitesi Tıp Fakültesi, Çocuk Cerrahisi Anabilim Dalı, Kocaeli, Türkiye

2 Serbest Hekim, Genel Cerrahi Uzmanı, Kocaeli, Türkiye

3 Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi, Çocuk Cerrahisi Kliniği, İstanbul, Türkiye

4 İstanbul Onkoloji Hastanesi, Anestezi ve Reaminasyon Kliniği, İstanbul, Türkiye

5 Ümraniye Eğitim ve Araştırma Hastanesi, Çocuk Cerrahisi Kliniği, İstanbul, Türkiye

ÖZ

GİRİŞ ve AMAÇ: Çalışmada, 3 yıllık süre boyunca, 3. basamak bir yanık tedavi merkezine yatırılarak takip ve tedavi edilen, 0-18 yaş grubundaki hastaların tüm verilerinin sunulması amaçlandı.

YÖNTEM ve GEREÇLER: Olgular yaş, cinsiyet, yanık nedenleri, yanığın meydana geldiği ortam, toplam yanık yüzey alanı, yanık lokalizasyonları, enfeksiyon oranı ve ajanları, yoğun bakım gereksinimleri, operasyon sayıları ve çeşitleri, yatış süreleri ve mortalite oranları dikkate alınarak incelendi.

BULGULAR: Yüzyüksek çocuk hastanın 77'si kız, 68'i erkek idi. Yanık en sık 67 (%46) hasta ile 1-3 yaş grubunda meydana gelmişti. Hastaların % 88'inde (131) 2. derece yanık mevcuttu. Tüm vakaların %60'unda yoğun bakım ve %88'inde operasyon gerekti. Otuzaltı hastada enfeksiyon dökümente edildi. En sık izole edilen ajan *Acinetobacter Baumannii* idi. Toplam 1192 adet operasyon yapılırken split thickness deri grefti en fazla yapılan operasyon idi. Toplam 3 hasta kaybedildi.

TARTIŞMA ve SONUÇ: Çalışma, İngilizce literatürü taradığımızda, çocuk yaş grubu yanıklarında yapılan bu kadar ayrıntılı bir çalışma için en yüksek hasta sayılarından birine sahip olması ile öne çıkmaktadır. Hastalar arasında ev ortamında sıcak su ile haşlanma en sık yanık sebebi idi. Bu da çocuk yaş grubu yanıklarının çoğunun basit koruma eğitimleri ve programları ile engellenebilir olduğunu gösterdi. Tüm vakaların %60'unda yoğun bakım ve %88'inde operasyon ihtiyacı olması yanık sonrası takip ve tedaviler ise mutlaka profesyonel merkezlerde yapılması gerektiğini ortaya çıkardı. Yanık merkezlerin sayısı artırılması ve eğitilmiş yardımcı sağlık personeli ile mortalite ve morbidite oranı düşürülebileceği sonucuna ulaşıldı.

Anahtar Kelimeler: Çocuk, yanık, etyoloji, enfeksiyonlar, operasyonlar

ABSTRACT

INTRODUCTION: We present the data for pediatric patients who were hospitalized, treated, and followed-up in a tertiary center for burn treatment for three years.

METHODS: The cases were examined for age, gender, causes of burns, the environment where the injury occurred, total burn surface area, the infection rate and agent, intensive care requirements, the number and types of operations and mortality rates.

RESULTS: Of the 145 children, 77 were female, and 68 were male. Second-degree burns were present in 131 patients (88%). Intensive care was required in 60% of the cases and surgical treatment was required in 88%. Infection was documented in 36 patients (24.8%). The most frequently isolated agent was *Acinetobacter baumannii*. A total of 1,192 operations were performed and split-thickness skin grafts were the most common operation. Three of the patients died.

DISCUSSION AND CONCLUSION: The study represents a detailed analysis of one of the largest samples of burn cases for this age group in the literature. Scalding with hot water at home was the most common cause of burns, which suggests that simple preventive measures and training programs can prevent most of the pediatric burns. The need for intensive care in 60% of the cases and for surgical treatment in 88% of the cases revealed that treatment and follow-up after burns should be done in specialized centers. It was concluded that increasing the number of healthcare centers equipped for caring burns may reduce the morbidity and mortality related to burns.

Keywords: Children, burns, etiology, infections, operations

İletişim / Correspondence:

Mustafa Alper Akay

Kocaeli Üniversitesi Tıp Fakültesi, Çocuk Cerrahisi Anabilim Dalı, Kocaeli, Türkiye

E-mail: pedcerr@gmail.com

Başvuru Tarihi: 01.10.2020

Kabul Tarihi: 03.11.2020

INTRODUCTION

Burns are significant health problems involving damages to epidermis and dermis, the protecting layers of the skin, and subcutaneous tissues such as muscles and bones due to the effects of extreme heat or cold, electricity, or chemical substances.

Burn injuries are a major cause of hospitalization and are associated with significant morbidity and mortality, particularly in children aged four years or below [1-3]. About half of the burns involve children, one-fourth of which are severe burns. Patients with burns should be considered and treated as patients with severe trauma.

Childhood burns place enormous socio-economic burden on individuals, their families and health services [2]. Burns are the fourth commonest type of trauma worldwide, after traffic injuries, falls and interpersonal violence [4]. The treatment of burns requires complex procedures and is expensive. Therefore, prevention is the most effective approach in dealing with burns. Epidemiological studies are of great potential in understanding the underlying causes and the prevention of burns.

This study aimed to describe the characteristics of the burn cases involving children, to highlight preventive measures, and to outline the factors that should be considered during the first aid and treatment processes. The findings of this study may contribute to future educational programs focusing on preventive measures.

MATERIAL AND METHODS

The study retrospectively evaluated a total of 145 patients aged 0-18 years who were treated in a burn unit at a tertiary healthcare facility for three years period. Patients were categorized based on age as follows: newborns (0-12 months), toddlers (1-3 years), preschoolers (3-7 years), grade-schoolers, and teens (7-18 years). Also, they were grouped based on gender as male and female. Age groups were also handled as boys and girls. For each age group, the location where the incident took place, the cause, depth, degree, surface area, and location of the burn, and surgical and non-surgical treatments were recorded. Infections were documented by the cultures of the samples from wound, tissues, blood, urine, and catheters; antibiotic treatments were planned based on these cultures. The morbidity,

mortality, and length of hospital stay were evaluated. This study was approved by the University Ethics Committee (KU/KAEEK 2015/04.15; project number: 2015/136).

RESULTS

The study represents a detailed analysis of one of the largest samples of burn cases for this age group in the literature.

Of 145 children treated for burns, 77 (53%) were female, and 68 (47%) were male. Twenty-nine patients (20%) were newborns, 67 (46.5%) were toddlers, 24 (16.5%) were preschoolers, and 25 (17%) were grade-schoolers or teens. The youngest was two months old, and the oldest was 17 years old. Hot liquids were the cause of burn in 123 patients (tea in nine patients, milk in seven, oil in three, soup in two, falling into boiling grape molasses in two). Fire or flames were the cause in 13 patients; nine patients had burns due to other reasons (stove, lightning, hot pudding, heater gels, helium gas or natural gas explosion, and blow dryer) (Table 1).

Table 1: Distribution of burn cases according to causes and age groups

Causes of burns	Age groups				Total	
	0-1 age	1-3 age	3-7 age	7-18 age	n	%
Hot water	23	54	13	10	100	69
Fire-Flame	0	1	3	9	13	9
Tea	3	4	2	0	9	6
Oil	0	3	0	0	3	2
Milk	0	2	3	2	7	5
Others	3	3	3	4	13	9
Total	29	67	24	25	145	100

Location of The Incident

Burns occurred at home in 135 (93%) cases and other places in 10 (7%) cases.

Degree of Burn

With 131 cases (90%), second-degree burns were the most common type, 88 (67%) of which were superficial burns. Three patients had third-degree burns, and 11 patients had first-degree burns.

The Surface Area of The Burn

In 65 (45%) patients, surface area of burn was <10% of body area; it was 11-20% in 49 (34%) patients, 21-30% in 26 (17.4%) patients, 31-50% in four (3%) patients, and 51% in one (0.6%) patient. Of the burn cases that resulted in death, the surface

area of the burn was 22% in the patient who had burns due to hot water, 51% in the patient who had burns due to a natural gas explosion, and 34% in the patient who had burns due to falling into boiling milk (Table 2).

Table 2: Distribution of patients according to burn surface areas

Burn surface area / body surface area	N	Rate of patients (%)
% 10 or less	65	45
%11 - 20	49	34
%21-30	26	17.4
%31-50	4	3
%51 or more	1	0.6

Location Of Burns

The most affected body parts were upper and lower extremities; the least affected regions were gluteal region (n = 9) and scalp (n = 6).

Operations

Patients were approached conservatively with burn dressing on the first visit. Burn necrosis was expected to complete for 48 to 72 hours. At the end of this period, debridement, graft repair or conservative follow-up decision was made according to the condition of the burn area.

Some treatment was needed in 88% of the patients. Operations included wound dressing and debridement, fasciotomy and escharotomy of the upper and lower extremities, skin graft, and amputations. Consultation was requested from the plastic surgery department in cases where reconstruction with flap was required in upper extremity burns, although not often. Surgical interventions were performed together. Amputation was required for 1 patient, as indicated in table 3. Help was sought from the orthopedics department. Likewise, the intervention was done together.

Short and long splints were used on the lower and upper extremities in 29 patients. The splint was used to stabilize the grafts and to protect them from contractures.

Forty-nine patients (40%) underwent multiple distinct operations. The most commonly used procedure was split-thickness skin grafts (320 times). Maximum number of operations on a single patient was 50; the minimum was one. The total number of operations on 145 patients was 1,192 (Table 3).

Table 3: Operations

Transactions	Number of Patients	Total number of transactions	Number of transactions in a patient	
			Least	Most
Debridement	Big 31	150	1	50
Dressing	Medium 16	45	1	11
Split thickness skin graft	Big 60	320	1	37
	Medium 13	36	1	11
Full thickness skin graft	3	9	1	4
Split thickness skin graft	32	218	1	32
Escharectomy	72	318	1	16
Opening of fasciotomy	8	20	1	5
Closing of fasciotomy	4	9	1	4
amputation	1	7	1	-
Expansion of contracture	3	3	1	-
Scar revision	1	1	1	-
Arm splint	Long 15	25	1	4
	Short 2	6	1	5
Leg Splint	Long 7	19	1	5
	Short 5	6	1	2
Total		1192		

Infections And Their Characteristics

Samples collected and cultured at various stages of treatment indicated infections in 36 (25%) patients. Most frequently isolated microorganism was Acinetobacter baumannii (18 patients, 50%) followed by Staphylococcus aureus (in 14 patients, %40) and Pseudomonas aeruginosa (in 12 patients, %32) (Table 4).

Only wound culture was positive for infections in 16 patients (44%); only blood culture was positive in six patients (16%); only urine culture was positive in two patients (5%). Twelve patients (32%) had positive results for multiple samples. Seven patients (19.5%) had positive results for wound and blood cultures; three patients (8.5%) had positive results for wound and urine cultures; two patients (5%) had

positive results for wound, blood, and central catheter cultures (Table 5).

Table 4: Microorganisms isolated in cultures.

Microorganism	Number of patients	%
Acinetobacter Baumannii	18	50
Stafilokokoccus Aerous	14	40
Psödomonas Aeroginosa	12	32
Enterococcus Fecalis	6	17
Corynebacterium Striatum	5	14
Stafilokokoccus Epidermidis	4	11
Klepsiella Pnömonia	4	11
Stafilokokoccus Hominis	1	0,2
Enterococcus Cloacea	1	0,2
Candida Albicans	1	0,2
Candida nonalbicans	1	0,2
Streptococcus Disgalaktia	1	0,2

Table 5: Number and numbers of breeding according to culture material

Culture	Number of Patients	Rate (%)
Reproduction in one material	Wound and Tissue	45
	Blood	17
	Pee	5
Reproduction in multiple materials	Wound + Blood	19.5
	Wound + Pee	8.5
	Wound + blood + catheter	5
	Total	36
Total	100	100

The patient who had burns inflicted by falling into a milk boiler and died was positive for Streptococcus dysgalactiae in the wound culture. Another patient who had burns inflicted by fire and died was positive for Pseudomonas aeruginosa in the wound culture. Two of the patients with infections had burns due to hot tea; one patient had burns

inflicted by falling into boiling grape molasses. The remaining 23 patients had burns due to boiling water. Of those who were positive for infections, 22 (61%) were male, and 18 (50%) were toddlers (Table 6).

Table 6: Age and sex distribution of patients with reproductive cultures

Age	Male		Female		Total	
	n	%	n	%	n	%
0-12 months	6	17	4	11	10	28
13-24 months	9	25	2	5	11	30
25-36 months	6	17	1	3	7	20
Over of 36 months	1	3	7	19	8	22
Total	n	22	14	36		
	%	62	38	100		

Relationship between infection and the length of hospital stay

The length of hospital stay ranged from 4 to 44 days, with a mean duration of 16.5 days. One of the patients who had died was hospitalized for four days; others had been hospitalized for more than ten days. The mean length of hospital stay was 20 ± 1 days for girls and 22 ± 1 days for boys.

Relationship between infection and burn surface area

It was found that patients who had infections were those with burn area of 10% or more.

Treatment of infections

Treatments were based on the antibiogram tests of the bacteria isolated from patients. Most commonly used antibiotic was ampicillin-sulbactam; other antimicrobial agents used were meropenem, imipenem, colomycin, amoxicillin-clavulanic acid, cefoperazone-sulbactam, amikacin, ornidazole, and fungostatin.

Length of stay

Intensive care was needed in 60% of patients. Length of hospital stay ranged from two to 44 days; three-quarters (108 patients) of the patients stayed for 10 days or less. Eleven patients (0.08%) stayed for more than 20 days.

Mortality and Morbidity

One of our patients who died was a 12-year-old girl. As a result of natural gas explosion, there were 51% deep burns on the face, 2 hands and arms, the entire back and 2 lower extremities. The general situation was badly brought from abroad by helicopter. They had a wide variety of reproduction in wound, blood and urine cultures. She was lost on the 4th day of hospitalization with a septic shock.

The second patient who died was a 4-year-old male patient who had fallen into a milk cauldron. He had 45% 2 degree deep burns on his back and trunk, both lower and upper extremities. In their culture, candida albicans and streptococcus disgalactica reproduced. 11. He died on the day of infections.

The third patient who died was a 3-year-old girl. It had come as a result of scalding with hot water. The trunk, back, both upper extremities and 2nd degree had superficial and deep burns. This patient died on the 20th day of hospitalization due to sepsis.

The overall mortality rate was 2%. Less than half of the patients were from other cities (58 patients, 40%); these patients were believed to be followed up in the cities where they would live after being discharged. A total of 140 (96.6%) patients were discharged in good condition, except for two patients (1.4%) who refused treatment and three patients (2%) who died.

DISCUSSION

Burn injuries are a common health problem in all countries and are associated with a significant physical and mental burden for the patient, their family, and society. Epidemiological studies are instrumental in providing insight into the factors causing burns and tailoring protective measures.

The study represents a detailed analysis of one of the largest samples of burn cases for this age group in the literature. Among children, those aged 5 or younger represented the highest number of cases. Half of the patients were ten years old or younger. Those aged 12 months to three years were found to be at the greatest risk. In a study on the epidemiology of burns [5], 68.7% of the patients were children under six years of age. Additional measures are necessary for this period when children start to walk and try to explore and recognize their surroundings.

The most frequent cause of burns was hot liquids, followed by flame/fire. Other studies also indicated that burns due to hot liquids were more frequent and burns due to fire or electricity were rare [7-11].

The majority of the burns were in the upper extremities (84%), followed by the trunk (62%), head and neck region (61%), and genital region (13%) [12,13]. Another study found head and neck burns in 7.4% of the patients and burns in the perineal region in 11% [6, 12]. In our study, burns were most commonly in the extremities. Higher rate of upper extremity burns might be attributed to the fact that children under five years of age tend to recognize objects by hand.

The most common burn type was scalding due to hot liquids; these burns had the highest total affected body surface area. In these cases, grafts and escharotomy were the most common operations. Scalding burns were often associated with extremity injuries. These burns involved joints, requiring multiple operations, which has suggested that healthcare staff, surgeons, in particular, working at burn centers need to master the anatomy and surgery of the joints.

In case of infections, sepsis is a significant cause of morbidity and mortality. Infections in the patients staying in the intensive care unit due to burns are often related to the factors such as the percent of the body involved, burn size, ventilator requirement, and invasive interventions [14]. Santucci et al. found that the patients with infections had more extensive burns and stayed in hospital longer [15]. Oncu et al. reported the risk of infection to be related to patients' clinical status, invasive interventions, age, ventilator need, and length of hospital stay [16]. In our study, the percent of the body involved was greater than 10% in all patients with infection. The length of hospital stay was less than ten days in the non-infected patients (109 patients, 75%) while the mean duration of hospital stay was 21 days for the infected patients. These data suggest that larger burn size, longer duration of hospital stay, and infection are interrelated.

Staphylococci and streptococci are common infectious agents in the first few days since the most common causes of burn infections are bacterial flora of the body while hospital-acquired agents

Escherichia coli, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* infections are common in days 3-7. Various studies indicated *S. Aureus* and *P. aeruginosa* as the most common agents [14,17]. In our study, the most common agent was *Acinetobacter baumannii* (50%). Although this appears to differ from the abovementioned common agents, recent studies indicate an increasing number of infections with *Acinetobacter* and antibiotic-resistant strains [18]. The increase of *Acinetobacter* strains is a result of resistance development due to the widespread use of broad-spectrum antibiotics due to the changes in systemic antibiotics for *Pseudomonas* and in nosocomial pathogen patterns. The presence of different infectious agents may be attributed to the variations in time-course of infections and hospital flora. The result suggests that each clinic should identify the common microorganisms in their flora and develop appropriate antibiotic strategies.

Another striking finding was that infections were more common in toddlers (aged 1-3 years), which might be attributed to increased mobility in this age group and difficulty in controlling their movements, resulting in increased physical contact with surfaces in the hospital environment. The prevalence of infections among under 1 years old, might be attributed to the fact that infants have less-developed immune resistance to different microorganisms, especially those of hospital origin. Indeed, children under the age of three constituted approximately 80% of all infected burn patients; isolation of these age groups is expected to cut the rate of hospital acquired infections significantly.

Similar to previous studies, the infection rate was found to increase with the affected body surface area. However, the number of infections was found to be low among the patients with an affected body surface area of $\geq 30\%$ since the total number of patients in this group was low.

Small sample size in this group may be the reason for only 36 documented infections in 145 patients and is one of the limitations of this study.

Antibiotic treatments were based on the antibiogram tests of the bacteria isolated from patients. Thirtysix patients had positive results in cultures with growth in single material in 67%. The

success of the antibiotic treatments initiated according to the single material antibiogram results prevented repeated growth in different materials. This approach demonstrates the importance of continuing therapies based on antibiogram results, not on empirical antibiotic treatments.

Among the single materials, the most common site of infections was the wounded site, which indicated the importance of the isolation of the wounded site and attention to sterility during debridement and dressing. The presence of infections at sites treated with care in operating room conditions has shown that burn patients need to receive care in specialized centers. Procedures such as debridement and dressing in burn patients should not be performed in dressing stations or inpatient services.

The overall mortality rate was 2%. The type of burns was scalding in 66% and fire in 33%. When the causes of mortality were examined, sepsis and septic shock were observed. Their common feature was that the burned surface areas were also large. This revealed that the patient should be protected from infections more carefully in this type of large surface burn. In another study, the mortality rate was 2.28% and was significantly higher among those with fire-related burns [19]. In the study conducted by Diler et al., the patient whose large body area burned as a result of a flame burn was lost as a result of infection and a similar result was revealed in our study. The patients who have been referred from other cities (58 patients) are believed to be followed up in the cities where they live after being discharged. The morbidity rates of these patients are not known.

In conclusion, burns lead to severe physical and psychological sequelae in the acute and chronic phases. Although advanced technologies helped improve the treatment of burns, raising public awareness and preventing burns in the first place are easier and prevent financial and mental costs associated with burns. Attention and precaution are the most critical rules in preventing burns. The facts that 88% of all cases required surgical intervention and 60% required intensive care indicate that the most important action to take in case of burns is to provide first aid by trained people and to take the

victim to a healthcare facility equipped for caring burn patients. Increasing the number of healthcare centers equipped for caring burns may reduce morbidity and mortality related to burns significantly.

If burn centers cannot be increased, it may be another suggestion to increase the number of fully equipped ambulance helicopters for burns. In this way, patients can be transported to burn centers under appropriate conditions.

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