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CLINICAL ASSESSMENT OF PEDIATRIC BURNS: A RETROSPECTIVE STUDY

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Abstract

Burn injuries represent a significant aspect of pediatric traumas, particularly prevalent during early childhood, involving a critical patient population characterized by elevated mortality and morbidity rates. This study explores burn incidents in children aged 0-6 years admitted to the Burn Unit of a tertiary hospital between January 1, 2016, and June 20, 2023, within the context of the existing literature. Additionally, it conducts an analysis of burn etiology, distribution, severity, and treatment interventions, categorizing a sample of 241 pediatric burn patients, predominantly within the 0-18 month age range. Children are categorized into three groups based on Sigmund Freud's "psychosexual development stages": 0-18 months, 18-36 months, and 36-72 months. Statistical analyses were performed using SPSS 25, with a predetermined significance level of 0.05. Burns commonly present as scalds, flames, and chemical burns, primarily falling within the 11-20% range and predominantly involving second-degree burns. Treatment approaches include a combination of dressing and medical treatment in 68% of cases, debridement under general anesthesia in 16.2%, and grafting in 15.8%. The infection rate is 10.8%, with *Pseudomonas aeruginosa* emerging as the predominant pathogen, and the mortality rate reported at 0.8%. The average hospitalization duration is 9 days. Highlighting the paramount importance of meticulous planning in managing burns in children under 6 years old and emphasizing the influence of parental factors, the study advocates for

educating parents on safety measures as a crucial step in mitigating burn incidence. Stressing the pivotal role of epidemiological investigations in comprehending and preventing the root causes of burns, the research suggests that more extensive age-range studies and multicenter approaches could provide more robust epidemiological insights for the effective management of burn cases.

Keywords: Burns, child, epidemiology, pediatric, preschool child, surgery

Özet

Yanıklar, çocukluk çağı travmalarının önemli bir parçasını oluşturur, özellikle okul öncesi dönemde sıkça görülür ve ciddi mortalite ve morbidite oranlarına sahip kritik bir hasta grubunu içermektedir. Bu çalışma, 1 Ocak 2016 ile 20 Haziran 2023 tarihleri arasında bir üçüncü basamak hastanenin Yanık Ünitesi'ne başvuran 0-6 yaş aralığındaki çocuk yanık vakaları literatür çerçevesinde ele almaktadır. Ayrıca yanık etiyojisi, dağılımı, şiddeti ve tedavi müdahalelerini detaylı bir şekilde sınıflandırarak, çoğunluğu 0-18 ay arasındaki 241 pediatrik yanık hastasını içeren bir örneklemi analiz etmiştir. Çocuklar, Sigmund Freud'un "psikoseksüel gelişim evreleri" teorisine dayanarak 0-18 ay, 18-36 ay ve 36-72 ay olmak üzere üç gruba ayrılmıştır. İstatistiksel analizler SPSS 25 paket programı kullanılarak gerçekleştirildi ve anlamlılık düzeyi olarak 0.05 kabul edildi. Yanıklar genellikle haşlanma, alev ve kimyasal yanıklar şeklinde olup, çoğu %11-20 aralığında ve 2. derece yanıkları içermektedir. Tedavi yaklaşımları arasında, %68 pansuman ve medikal tedavi kombinasyonu, %16,2 genel anestezi altında debridman, %15,8 greftleme yer almaktadır. Enfeksiyon oranı %10,8'dir, en sık izole edilen patojen *Pseudomonas aeruginosa* ve mortalite oranı %0,8'dir. Ortalama hastanede kalış süresi 9 gündür. Bu çalışma, 6 yaş altındaki çocuk yanıklarının yönetiminde dikkatli planlamanın ve ebeveyn faktörlerinin önemini vurgulayarak, ebeveynlere güvenlik önlemleri konusunda eğitim verilmesinin yanık insidansını azaltmada önemli bir adım olduğunu belirtmektedir. Yanıkların altında yatan nedenleri anlamak ve önlemek için epidemiyolojik çalışmaların önemini vurgulayarak, daha geniş yaş aralıklarının kapsayan ve çok merkezli çalışmaların yanık vakalarının etkili yönetimine daha sağlam epidemiyolojik bilgiler sağlayabileceğini öne sürmektedir.

Anahtar Kelimeler: Cerrahi, çocuk, epidemiyoloji, okul öncesi çocuk, pediatrik, yanıklar

1. Introduction

Burns encompass tissue damage resulting from exposure to diverse sources such as heat, chemicals, electricity, or radiation (Pratama, 2022; Burgess, 2022). The spectrum of burn injuries ranges from minor medical concerns to life-threatening emergencies, contingent upon the burn's location and the extent of the damage. In addition to the physical ramifications, burns exert profound impacts on societies through psychological and economic repercussions. Epidemiological investigations play a pivotal role in discerning the causative factors of burns and potential hazards. (Eunsol, 2021; Andriadze, 2022)

Globally acknowledged as a substantial public health concern, burns, as per the World Health Organization's 2023 data, contribute to approximately 180,000 annual fatalities and are posited as the fifth most prevalent cause of childhood injuries. This impact is particularly accentuated in low- and middle-income countries, where the incidence is determined to be sevenfold higher ("Burns" n.d. WHO, 2023). Furthermore, the estimated mortality rate attributed to burns among children stands at 2.5 per 100,000 individuals (Özlü&Başaran, 2022; Sengoelge, 2017).

The mortality rate among individuals who experienced burn injuries during childhood has been determined to be 1.6 times higher compared to those without such injuries (Duke JM, 2015). Despite being largely preventable, burn injuries continue to represent a significant public health concern. A study by Jordan KC et al. (2022) elucidated that approximately half of the globally affected burn cases involve pediatric individuals, predominantly under the age of 5. Burn injuries, especially prevalent during the preschool period, underscore the imperative need for effective control of risk factors during this developmental stage (Binet A, 2023). In this context, the present cross-sectional study specifically aims to retrospectively evaluate burn injuries occurring in the preschool period (<6 years). The study adopts an epidemiological perspective, involving the retrospective analysis of burn cases in children under 6 years of age who were hospitalized for burn injuries, along with an examination of their burn treatments.

2. Material and Methods

This study, conducted under the approval of the Samsun University Local Ethics Committee with the protocol number SÜKA EK-2023 12/17 obtained on June 21, 2023, comprised 241 cases aged 0-6 who underwent burn treatment at Samsun Training and Research Hospital between January 1, 2016, and June 20, 2023. In this retrospective analysis, demographic parameters,

including age and gender, along with clinical and surgical findings, and specific burn-related details such as etiology, burn area, percentage, degree, treatment modality, infection status, hospitalization duration, and clinical progression, were extracted from the hospital automation system. Cases lacking adequate data within the stipulated period were excluded from the study.

Children were stratified into three age groups: 0-18 months, 18-36 months, and 36-72 months. This classification aimed to align with the fundamental developmental stages in children's lives. Consequently, children were grouped into oral (0-18 months), anal (18-36 months), and phallic (36-72 months) periods, following Sigmund Freud's psychoanalytic theory of "psychosexual development stages."

Burn causes were categorized as scalding, flame, chemical, and electrical burns. Burn areas were computed using the rule of nines and the modified Lund-Browder method (Figure 1), and were assessed in three categories: below 10%, 10-20%, and above 20%. Burn regions were classified as head-neck, trunk, upper extremity, lower extremity, and multiple regions. Treatment modalities encompassed burn dressing, supportive medical treatment, burn debridement under general anesthesia, and grafting procedures. Infection development rates underwent statistical analysis based on pathogens isolated from blood and wound cultures, with the identified agents being ascertained.

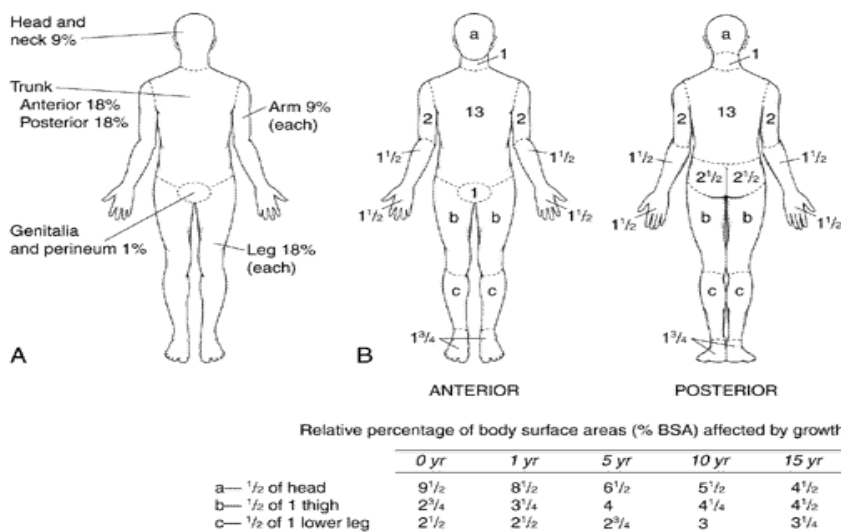


Figure 1. (A) Rule of nines. (B) Lund and Browder chart "Lund and Browder Chart." 2022.

The research data underwent encoding and computerized assessment using the Statistical Package for Social Sciences (IBM SPSS 25) for statistical analyses. Descriptive statistical methods, including numerical, percentage, and arithmetic mean assessments, were applied for data evaluation. Group comparisons were conducted using the Pearson chi-square test and One-Sample chi-square test. A significance level of 0.05 was established for all analyses.

3. Results

In our investigation, the mean age of the 241 burn patients was determined to be 1.77 ± 0.96 years, with 62.7% of the subjects identified as male children. The distribution across age groups revealed the highest proportion within the 0-18 months range, constituting 46.9%. Subsequently, the 18-36 months range exhibited 38.2%, and the 36-72 months range accounted for 14.9%. Comprehensive details regarding these outcomes are elucidated in Table 1.

Table 1. Age Distribution

	Frequency	Percent
0 - 18 month	113	46.9
18 - 36 month	92	38.2
36 - 72 month	36	14.9
Total	241	100

The analysis of age distribution reveals that the predominant majority of patients (92.1%) experienced scald burns. Admission rates to the hospital due to flame burns and chemical burns were determined to be 7.1% and 0.8%, respectively (Table 2).

Table 2. Burn etiology

	Frequency	Percent	
Valid	Scalding	222	92.1
	Flame	17	7.1
	Chemical	2	0.8
	Total	241	100

Upon location-based evaluation, the prevalent type of burn identified was multiple region burns, comprising 61% of cases, with lower extremity burns following closely at a frequency of 12.9% (Table 3).

Table 3. Burn Regions

		Frequency	Percent
Valid	Head-Neck	9	3.7
	Trunk	26	10.8
	Upper Extremity	28	11.6
	Lower Extremity	31	12.9
	Multiple	147	61
	Total	241	100

In the evaluation of burn percentages computed using the Modified Lund-Browder method, the most commonly encountered category comprised burns ranging from 11% to 20%, accounting for 46.1%. Burn percentages of 10% and below were noted in 39% of patients, whereas percentages of 20% and above were identified in 14.9% of cases (Table 4).

Table 4. Percentages of burns

		Frequency	Percent
Valid	10% and below	94	39
	11% - 20%	111	46.1
	20% and above	36	14.9
	Total	241	100

Upon evaluating the burn depths, second-degree burns were the most commonly encountered, accounting for 79.7% (Table 5).

Table 5. Degrees of Burns

		Frequency	Percent
Valid	1. Degree	4	1.7
	2. Degree	192	79.7
	3. Degree	23	9.5
	2. ve 3.	22	9.1
	Total	241	100

In the context of burn treatments, the prevailing approach involved the concurrent use of dressing and medical treatment (68%). Furthermore, 16.2% of patients underwent burn debridement under general anesthesia, and 15.8% received treatment through graft application.

Table 6. Distribution of Treatment Protocols

		Frequency	Percent
Valid	Dressing+medical treatment	164	68
	Debridement	39	16.2
	Graft	38	15.8
	Total	241	100

In 10.8% (n=26) of cases, infection developed. The isolated infectious agents included *Pseudomonas aeruginosa*, *S. aureus*, *E. coli*, *Acinetobacter baumannii*, *Candida parapsilosis*, *Klebsiella pneumoniae*, *Schillingomonas paucimobilis*, *Staphylococcus saprophyticus*, *Enterobacter cloacae* complex, and *Pseudomonas spp*, with 9.3% identified in blood cultures and 90.7% in wound cultures. *Pseudomonas aeruginosa* was the most frequently isolated agent. The average hospitalization duration for burn cases was 9 days. Regarding the clinical course, 96.7% of patients were discharged during this period, but unfortunately, 0.8% (n=2) resulted in mortality, primarily due to sepsis. In a case necessitating prolonged hospitalization with vascular access difficulties, the attempt of femoral central catheter insertion resulted in thrombosis and subsequent acute tubular necrosis. Despite efforts to find an appropriate center for hemodiafiltration in all consultations conducted during this process, the lack of a suitable center

led to the necessity of proceeding with supportive medical treatments, including peritoneal dialysis. Despite all medical interventions, the patient's condition resulted in a fatal outcome.

4. Discussion

Epidemiological investigations serve as pivotal resources for understanding, addressing, and averting public health challenges. Burns emerge as a substantial public health issue, with pediatric burns delineating a critical patient cohort characterized by elevated morbidity and mortality rates, constituting a noteworthy proportion of the overall burn cases (Rosanova vd., 2013). Our study has unveiled significant insights into burns commonly encountered during childhood.

Within the spectrum of childhood traumas, burns frequently rank as the third most prevalent cause, with half of the affected patients falling below the age of 5 (Csenkey vd., 2019). This study specifically delves into burns occurring in children under 6, termed the preschool period. Given the retrospective nature of this cross-sectional study, only burn patients requiring hospitalization for treatment were included to ensure data clarity. Although this approach might be perceived as a study limitation, the challenges in comprehensively identifying factors such as parental attempts at conservative measures beyond physician-recommended protocols and the diverse services received from various outpatient clinics in the management of patients undergoing outpatient burn treatment were acknowledged. Consequently, patients receiving outpatient burn treatment were excluded from the study.

The preschool age group represents a developmental stage characterized by increased physical activity, balance challenges, and incomplete cognitive awareness in children. Moreover, the heightened metabolic rates and delicate skin structures in preschool-aged children may render them more susceptible to burn injuries (Başaran A & Özlü Ö, 2022). In this context, meticulous planning that considers growth and developmental milestones, skin characteristics, and psychosocial needs is paramount in the management of pediatric burns. Recent advancements in standard care protocols implemented in burn centers have resulted in a notable reduction in mortality rates within this patient demographic (Capek KD, 2018). These protocols emphasize factors conducive to improving the health status of burn patients, encompassing aspects like nutrition, resuscitation, early debridement, and grafting (Yasti, 2015). Effective management of pediatric burns contributes significantly to reducing mortality rates in this

population. Evaluation of the prevailing treatment algorithms in our burn unit has yielded a mortality rate of 0.8% in the specified age group, diverging from findings in existing literature (Olatain, 2007; Yiğit, 2022). Notably, Olatain et al. reported an 11% mortality rate, while Yiğit et al. documented a 1.45% rate in their case series. Additionally, a retrospective study conducted in Sudan, focusing on hospital-based data, revealed burns as the fourth most common traumatic injury type, with a mortality rate of 5.9% (Bakhiet, 2023). In South Africa, a retrospective cohort study found an overall mortality rate of 4.4% for pediatric burns, with a higher mortality rate among transferred patients compared to directly admitted cases (Mashavave, 2020). Another study in Nepal reported a prevalence of acute pediatric burns in a hospital setting to be 29.71%, with a mortality rate of 10.89% (Nakarmi, 2020). Our mortality results indicate a trend lower than reported in the literature, which can be ascribed to factors such as a smaller case volume, successful implementation of contemporary burn treatment algorithms, early debridement, meticulous infection control, and effective interdisciplinary collaboration within the burn care team. Ongoing research and advancements in treatment modalities for pediatric burns hold promise for achieving enhanced clinical outcomes in this vulnerable patient cohort.

The significance of parental factors is underscored by the study, revealing a higher incidence of burns in infants aged 0-18 months (46.9%) compared to children aged 18-36 months and 36-72 months. Existing literature has noted a markedly elevated prevalence of male children in cases of preschool burns treated in hospital settings. This observation is grounded in the proclivity of male children to manifest more active behavior than their female counterparts during childhood (Haberal et al., 1995; Yasti et al., 2011). In our study, we also identified a high frequency of male subjects, aligning with existing literature, with a determined rate of 62.7%.

Childhood burns are influenced by variables such as age, gender, socioeconomic status, and family structure. Scald burns result from exposure to hot liquids at home, while flame burns typically arise from domestic accidents and fires (Mohan Kumar T, 2023). In situations where safety measures within the home are insufficient, children may be at an increased risk. Scald burns, constituting the primary reason for referral to our burn unit at a rate of 92.1%, align with findings in the literature. A retrospective 2-year study involving 13 burn centers in Austria and New Zealand reported scald burns accounting for 56% of 730 cases (Riedlinger, 2015), although our rates are higher. Children often experience these burns due to home accidents involving spills

of boiling water, tea, milk, tipping kettles, and contact with stoves. In this context, the vigilant behavior of parents is crucial in preventing such accidents by enhancing home safety.

In accordance with our findings, burns involving multiple anatomical regions constitute the predominant presentation, accounting for 61% of observed cases. Instances characterized by a burn percentage ranging from 11 to 20%, classified as second-degree burns utilizing the modified Lund Browder method, are notably prevalent. Corroborating our observations, a study by Fernandes et al. among pediatric and adolescent populations underscores second-degree burns as the predominant type, impacting 62.6% of scrutinized cases (Fernandes, 2012). These observations imply a correlation with the diminished body surface area in children relative to adults, the attenuated cutaneous structure in pediatric patients, and their elevated metabolic rates.

A majority of burn cases were effectively managed through a combined approach encompassing bedside dressing alterations and medical interventions (68%). Approximately 16.2% of patients necessitated burn debridement under general anesthesia, while graft applications were mandated in 15.8% of cases; both procedures were executed successfully. Within the medical literature, early surgical debridement within the initial 48 hours following burn injury is deemed the standard of care for burns extending into the deep dermis. Early debridement has been documented to confer reductions in infection and complication rates, abbreviated hospitalizations, and expedited burn wound healing (Bolton, 2019). Our clinical preference for early debridement aligns with this practice, endorsing its efficacy in patient management.

In 10.8% of burn cases, infections developed. Burn infections typically involve bacterial flora, with early occurrences of Staphylococcus and Streptococcus infections, followed by an increased prevalence of hospital-acquired pathogens like Escherichia coli, Klebsiella pneumoniae, and P. aeruginosa within 3-7 days. Infections with Acinetobacter and antibiotic-resistant strains also exhibit an upward trend. Literature presents variations in the frequently identified causative agents, often citing S. aureus and P. aeruginosa (Taneja vd., 2004; Belba vd., 2004; Diler vd., 2012). However, this study identified P. aeruginosa as the most common agent. We attribute these differences to variations in infection timings and hospital flora. Each clinic should crucially determine its microbial flora and develop appropriate empirical antibiotic strategies for effective infection control.

The average hospitalization duration for burn cases was 9 days, with a discharge rate of 96.7% and a mortality rate of 0.8%. Mortality was predominantly sepsis-related, consistent with similar findings in the literature (Stanojcic vd., 2018; Manning vd., 2018). Managing burn patients poses challenges, exemplified by the difficulty in locating a suitable hemodiafiltration center for a patient with acute tubular necrosis due to central catheter complications and the prioritization of non-burn patients in pediatric intensive care units during equipment saturation. This underscores the imperative for burn units to possess the capacity to effectively intervene in all potential complications.

The limitations of our study, including its retrospective design, focus on hospitalized burn cases in children under 6 years old, and its single-center approach, introduce constraints. Therefore, the execution of multicenter studies that encompass a wide range of data, spanning from outpatient treatment of mild burns to severe burns requiring intensive care across all age groups, would contribute to attaining more robust and reliable epidemiological outcomes.

5. Conclusion

In conclusion, our conducted research elucidates the prominence of pediatric burns as a significant public health concern, particularly during the preschool period. The prevalence of these burns is notably concentrated among male children aged 0-18 months, with scald burns emerging as the predominant etiological factor and multiple region burns being the most frequently encountered type. Our findings underscore the critical importance of the multidisciplinary approach adopted by burn units, with the goal of optimizing health outcomes for children. In this context, it is imperative for parents to implement safety measures and safeguard their children from potential risk factors. Moreover, the promotion of awareness through health education and the active support of preventive measures are deemed pivotal in mitigating the incidence of pediatric burn incidents within the community. Nevertheless, based on our research results, despite positive clinical outcomes observed in the majority of patients, a minority faced complications, including infections, and sepsis resulting from these complications led to mortality in 0.8% of cases. These findings accentuate the urgency for sustained efforts in the effective management and prevention of pediatric burns.

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