

## WOUND CHANGES FOLLOWING DELAYED ADMISSION TO THE BURN CENTER

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**Abstract: Introduction:** This retrospective clinical study aimed to investigate patient profiles and wound degree changes, as well as cultural details, resulting from delayed admissions to burn centers following burn trauma.

**Methods:** Patients were categorized into five groups based on the time of hospital admission after the burn trauma: 0 days, 1<sup>st</sup> day, 2<sup>nd</sup> day, 3<sup>rd</sup> day, and 4<sup>th</sup> day and beyond.

**Results:** During the study period, 1092 patients were admitted to the hospital on the day of their burn trauma. A total of 324 (22.8%) patients — 131 (40.4%) women and 193 (59.6%) men — were admitted to the hospital 1 day or more after the trauma. These patients were admitted to the hospital 3.77 (min = 1, max = 27) days after receiving the burn, on average.

Of the 324 patients admitted to the hospital after 1 day, 57.9% were rural residents, and 42.1% were urban residents. The most common cause of wound site infection was *Staphylococcus aureus*, with 20.18%.

No statistically significant difference existed between the number of days of delayed hospital admission and the duration of hospitalization.

**Conclusion:** Delays in hospital admission significantly influence changes in burn wound conditions.

**Keywords:** Burn, admission delay, mortality, morbidity.

### INTRODUCTION

Burn injuries result in skin loss and can lead to various infections, heat loss, and immune suppression. The treatment of burn wounds has significantly improved over time, substantially enhancing the survival rates of patients. Infection prevention for burn patients starts promptly following the injury. Despite advancements in the utilization of antimicrobial therapy, escharotomy, and tangential excision, bacterial infec-

tions and associated complications persist as crucial contributors to burn morbidity and mortality (1, 2 3).

Burn injuries represent one of the most significant health problems faced by both developing and developed countries (4, 5). However, a significant gap exists between the number of burn patients and available burn units in the developing world. Limited functional specialized burn units mean that even severe burn patients cannot receive necessary treatment. Lack of knowledge, inadequate and inappropriate treatment, and limited access to tertiary centers (6) result in inadequate wound care until hospitalization in the burn care unit. Consequently, these patients are at high risk of developing systemic infections. Performing early treatment and skin grafting for these wounds (7) is sometimes impossible.

The present retrospective clinical study aimed to examine the demographic structure of burn patients who sought immediate treatment after burn trauma occurred at a tertiary care center in Turkey, as well as burn cases that sought treatment more than a day later. The study's purpose is to demonstrate the impact of delayed admission to the burn center on wound changes.

### MATERIALS AND METHODS

The current study investigated all burn cases that occurred between January 1, 2014, and January 1, 2020. A total of 1415 patients were included in this retrospective follow-up analysis, focusing on their admission as inpatients to the hospital.

Patients were categorized into five groups based on their hospital admission date after the burn trauma: 0 days, 1<sup>st</sup> day, 2<sup>nd</sup> day, 3<sup>rd</sup> day, and 4<sup>th</sup> day and above. The collected data encompassed patient demographics, admission date, burn mechanism, burn degree, burn percentage, and average duration of hospitalization. The collected data were then analyzed and grouped according to the admission day.

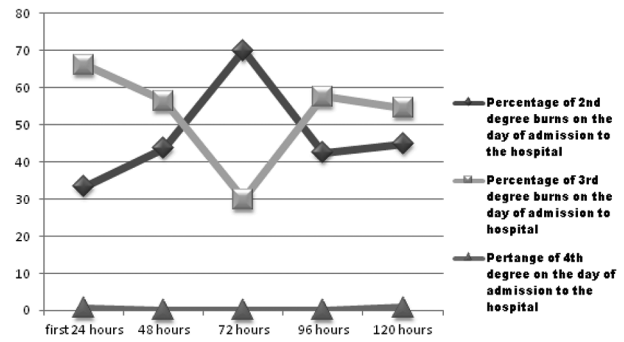
Categorical variables were assessed using chi-square tests, while normally distributed continuous variables were subjected to one-way analysis of variance. Post hoc tests utilizing Tukey’s honestly significant difference method were conducted following the one-way analysis of variance. Multiple comparisons were corrected using Bonferroni corrections. The Statistical Package for the Social Sciences for Windows (version 10.0; SPSS Inc., Chicago, IL, USA) was used for statistical analyses. P values below 0.05 were considered to be statistically significant.

**RESULTS**

Throughout the study duration, a total of 1415 patients were hospitalized due to burn injuries. Among them, 704 patients were admitted through the emergency room, while 711 patients were admitted from the outpatient clinic. The study cohort included 798 men (56.4%) and 617 women (43.6%).

Among the hospitalized patients, 1092 were admitted to the hospital on the same day as their burn trauma. Additionally, 324 patients (22.8%), consisting of 131 women (40.4%) and 193 men (59.6%), were admitted to the hospital one day or more after the burn trauma. On average, these patients were admitted to the hospital 3.77 days (min = 1, max = 27) after sustaining the burn injury (Table 1). The patients’ mean age was 12.86 ± 17.34 years (min = 1, max = 94). Burn degrees ranged from second to fourth.

When examining age distribution, similar trends were observed between patients who applied within



**Figure 1.** Distribution of age groups of those who were admitted on the same day and those who were admitted with a delay of 1 day or more

the first 24 hours and those who applied after the first 24 hours. Notably, there was a higher number of patients in the +65 age group who presented to the hospital at a later time (Figure 1).

The time of admission varied according to the etiology of the burns. When examining the causes of burns in cases of late admission, the causes were as follows: scalding burns accounted for 72.1%, flame burns for 12.7%, burns from contact with hot objects for 9.9%, electrical burns for 3.1%, chemical burns for 0.9%, and other causes for 1.3%. Analyzing the applicants with emergency burns did not yield statistically significant results (p = 0.75). In cases of late applicants, the most commonly burned areas were the right and left extremities (Table 2).

Of the 1,092 patients admitted within the first 24 hours, 55.1% were urban residents and 44.9% were

**Table 1.** Patient information overview

	Immediate applicants	Applicants in 24–48 hours	Applicants in 49–72 hours	Applicants in 73–96 hours	Applicants in 97 hours or more
Number of patients	1092	55	40	85	143
Percentage of patients	77.2%	3.9%	2.8%	6.0%	10.1%
Average percentage of burns ± SD	9.09 ± 6.325	10.58 ± 9.251	10.15 ± 6.542	10.72 ± 9.711	8.66 ± 6.301
Average length of hospital stay	5.46 ± 4.657	5.13 ± 3.278	6.65 ± 10.712	5.16 ± 5.442	5.78 ± 6.911

SD: standard deviation

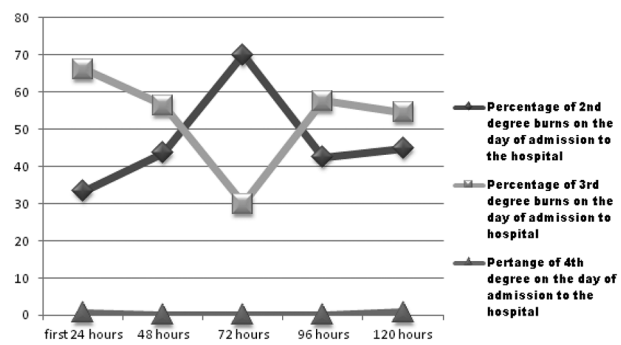
**Table 2.** Burn areas in early and late admissions

Burn site	Percentage in first 24 hours	Percentage of applicants after 24 hours	Total	Pearson chi-square
Head neck	16.3%	5.1%	21.4%	0.680
Right upper extremity	25.1%	6.9%	32.0%	0.654
Left upper extremity	24.9%	7.8%	32.8%	0.493
Chest anterior face + abdomen	20.6%	7.2%	27.8%	0.179
Chest back + back	5.7%	1.9%	7.6%	0.639
Perineum	3.7%	1.6%	5.3%	0.335
Right lower extremity	32.5%	10.0%	42.5%	0.635
Left lower extremity	31.1%	9.5%	40.6%	0.805

rural residents. Among the 324 patients admitted to the hospital after 24 hours, 57.9% were rural residents, and 42.1% were urban residents.

In admissions occurring up to 72 hours after the burn trauma, there was a gradual increase in the percentage of second-degree burns, while the percentage of third-degree burns gradually decreased. However, this change was not statistically significant ( $p = 0.08$ ) as shown in Figure 2. Beyond the 72-hour mark, the percentage of second-degree burns decreased, and the percentage of third-degree burns increased.

When considering patients with positive wound culture results, 90.1% of these cases were among those who presented to the hospital a day or more after the burn. Among patients who arrived a day or more after the burn, gram-positive bacteria were the most commonly isolated organisms (65.14%). Within this group, *Staphylococcus aureus* was the most prevalent, accounting for 20.18% of cases (Table 3).



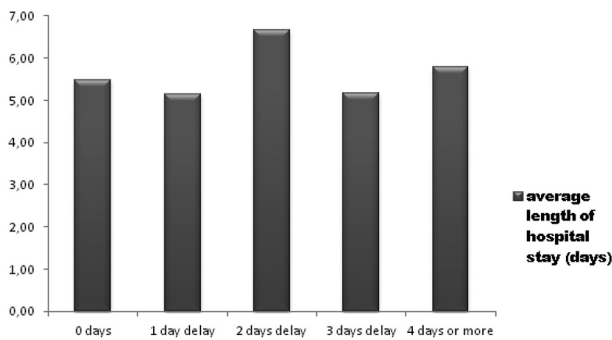
**Figure 2.** The degree of burn patients based on the time of admission to hospital

The mean hospital stay of all patients was  $5.50 \pm 5.189$  days. There was no statistically significant difference between the number of days of late admission and the duration of hospitalization.  $p = 0.548$ , (Figure 3).

Out of the total patients, 21 (1.48%) died, with two (9.5%) due to insufficient fluid replacement within

**Table 3.** Culture results of some microorganisms of early and late admitted patients

Main pathogen	Subgroup	Number of applicants in 24 hours	Number of applicants in 1-2 days	Number of applicants in 2-3 days	Number of applicants after > 3 days
<b>Gram(-)</b>					
<b>Acinetobacter</b>	Baumannii	7			1
<b>Escherichia</b>	coli	27	2	2	3
	faecalis		1	2	2
<b>Klebsiella</b>	pneumoniae	5			
<b>Pantoea</b>	agglomerans	3			
<b>Proteus</b>	mirabilis	4		1	1
<b>pseudomonas</b>	aeruginosa	28	1	2	5
	putida				2
<b>Serratia</b>	marcescens	1			1
<b>Gram(+)</b>					
<b>Enterococcus</b>	avium	1			
<b>Kocuria</b>	kristinae	4			
<b>Lactococcus</b>	garvieae				1
<b>Staphylococcus</b>	aureus	49	4	3	8
	epidermidis	67	2	2	8
	hemolyticus	21	2	2	2
	hominis	23	1	1	8
	lugdunensis	2			
	xylosus	3		1	1
<b>Streptococcus</b>	Spp.	1			2
	Agalactia	1			
	Mutis	1			
	pyogenes	1	1		1



**Figure 3.** Comparison of patients' late admission and hospitalization time

the first 24 hours, and the remaining 19 (90.5%) after 1 day or more, primarily from wound site infections.

## DISCUSSION

A burn is a devastating form of trauma affecting both developed and developing countries. Delayed presentation affects the prognosis by delaying fluid resuscitation, burn wound management, pain control, and wound infection control. In our study, the incidence of burn injuries was higher in men (56.4%) than women (43.6%), probably because the predominance of males in this study is due primarily to the fact that men are income-generating members of the family and are the most exposed to outdoor activities in our country. Males are less concerned about their health because of their large family (6). In the study conducted by Tasnim and Hubab et al. (8, 9), the incidence of men with burn trauma was found to be higher. Our work is in line with this.

Delays in burn treatment pose a significant issue in developing countries. Burn patients residing in rural areas may experience delays in gaining admission to burn units (10). This can be attributed to factors such as remote rural locations, lengthy travel distances, lack of accessible roads and transportation options, and limited availability of burn care facilities (11). For instance, burn survivors in Ghana often seek medical attention at local hospitals, and it takes an average of 60 days to reach burn units in the country. Unfortunately, burn wounds are frequently infected by the time patients receive treatment in such cases (11). Notably, only 48% of childhood burns in Ghana receive treatment in modern healthcare facilities, with 68% of these being addressed within 24 hours of the burn incident. Various factors contribute to treatment delays, including a lack of awareness regarding the severity of the condition and financial constraints (11).

In our study, 77.2% of patients were admitted to the hospital on the same day as their burn trauma, with 3.9% admitted within 24–48 hours, 2.8% within 49–

72 hours, 6% within 73–96 hours, and the remaining 10.1% experiencing an admission delay of 97 hours or more. Among the 323 patients admitted after 24 hours, 57.9% were residents of rural areas, while 42.1% resided in urban settings.

In the study by Duzgun et al., 50% of the patients were admitted 1 day or later (12). In our study, 22.8% of all patients were admitted to the hospital after a day. The rate of delayed admission was 36.4% in the 65+ age group. In the current study, we attribute this to living alone, which correlates with previous reports (12).

In our study, the average hospital admission occurred 3.77 days after the burn incident (min = 1, max = 27). In a study conducted by Duzgun et al. (12), this duration was reported as 5.4 days. We attribute the shorter duration in our study to improved accessibility of transportation options and a higher number of available burn centers.

In Khurramet al.'s study, the most common cause of burns in late admission was flash flame burn (67.30%), followed by scalding burn (7.69%) (6). In our study, scalding burns were the most common cause, and the most common burn sites were the right and left extremities.

In our study, the burn degree ranged from second to fourth in patients who were admitted more than 1 day after the trauma, while the percentage of second-degree burns in the group increased gradually in those admitted from the first hour to 72 hours, but the percentage of third-degree burns in the group gradually decreased. The percentage of patients with third-degree burns increased after 72 hours, while the percentage of patients with second-degree burns decreased.

Here, 72 hours is an important reason for the burn degree to be fully settled. At the same time, alternative medicine treatments are common in Turkey, generally in rural areas, where second-degree burns are treated with alternative medicine.

When looking at patients with positive wound culture results, 90.1% of these were positive in those who came to the hospital after 1 day or more. In the wound culture results of patients who came after 1 day or more, gram-positive bacteria were the most common (65.14%). The most common of these was *Staphylococcus aureus* (20.18%). In the study by Özbek et al (7), the most commonly cultured microorganism from infected burn wounds was *Pseudomonas aeruginosa* (38%), followed by *Staphylococcus aureus* (18.3%) and coagulase-negative staphylococci (13.6%).

The factors that will most affect the estimation of hospital stay in acute burn patients are infection incidence, wound depth, TBSA%, and inhalation injury (13). In our study, the mean hospital stay of all patients was  $5.50 \pm 5.189$ . There was no statistically significant

difference between the number of days of late admission to the hospital and length of hospital stay. In a study by Goswami et al., The length of stay was significantly low in the early excision group ( $14.9 \pm 6.37$  days vs.  $26.4 \pm 20.16$  days,  $p = 0.003$ ) as compared with the late excision group (14).

The limitations of this study are specific to its retrospective methodology. The analyzed data were from a single burn center in the Diyarbakir province and might thus be subject to presentation bias. Patients who sought treatment at burn units and plastic surgery polyclinics in the surrounding provinces were not included in the analysis.

## CONCLUSION

Delays in hospital admission stand out as the critical factor impacting burn wound treatment. Swift patient transportation, addressing hypovolemic shock upon initial hospitalization through appropriate

pre-treatment, early wound debridement, protein-calorie support, and prompt infection management are pivotal prognostic elements.

## Author Contributions

**Ebral Yiğit**- Concept, Design, Data collection &/ or processing, Literature search, Writing, Critical review; **Yasemin Demir Yiğit**- Supervision, Analysis and/or interpretation, Critical review

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## Sažetak

# PROMENE U RANAMA NAKON ODLOŽENOG PRIJEMA U CENTAR ZA OPEKOTINE

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**Uvod:** Ova retrospektivna klinička studija sprovedena je kako bi se ispitali profili pacijenata i promene u ranama u zavisnosti od stepena opekotine i izolovanim bakterijama, nakon kasnog prijema u centre za opekotine, a nakon trauma izazvanih opekotinama.

**Metode:** Pacijenti su kategorisani u pet grupa na osnovu datuma prijema u bolnicu nakon traume izazvane opekotinama: 0 dana, 1. dana, 2. dana, 3. dana i 4. dana i više.

**Rezultati:** Tokom perioda istraživanja, 1092 pacijenta je primljeno u bolnicu istog dana kada su zadobili opekotine. Ukupno 324 (22,8%) pacijenata — 131 (40,4%) žena i 193 (59,6%) muškaraca — je primljeno u bolnicu jedan ili više dana nakon traume. Ovi paci-

jenti su primljeni u bolnicu prosečno 3,77 dana (min = 1, max = 27) nakon što su zadobili opekotine.

Od 324 pacijenta koji su primljeni u bolnicu nakon jednog dana, 57,9% su bili ruralni stanovnici, dok je 42,1% bilo urbanog porekla. Najčešći uzrok infekcije mesta povrede bio je *Staphylococcus aureus* sa 20,18%.

Nije postojala statistički značajna razlika između broja dana kašnjenja pri prijemu u bolnicu i dužine hospitalizacije.

**Zaključak:** Kašnjenje u prijemu u bolnicu značajno utiče na promene u stanju opekotina.

**Cljučne reči:** Opekotine, kašnjenje pri prijemu, smrtnost, morbiditet.

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