Clinical Presentation and Outcomes of Burn Patients With Diabetes: A 5-Year Single-Center Experience

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ABSTRACT

OBJECTIVES: Diabetes mellitus is one of the most important independent risk factor for poor outcomes in patients with burn injuries. In this study, we aimed to determine the demographics characteristics, clinical presentation, and outcomes of burn patients with preexisting diabetes mellitus seen over the previous 5 years at a single burn center.

MATERIALS AND METHODS: We conducted a retrospective study that included all burn patients ≥18 years of age with a diagnosis of diabetes who were admitted to our unit over the previous 5 years (2018 to 2022). We collected demographics and relevant clinical data from medical records. Patients were evaluated by age subgroups and time interval between occurrence of injury and admission to a medical center.

RESULTS: Our study included 52 patients, with male-to-female ratio of 0.86:1 and mean age of 62.7 ± 12.4 years (range, 33-85 y). Scalding was the most common cause of the burn injury. A total of 32.7% of the patients had burns affecting their hands, either as part of a more extensive burn or as an isolated injury. The median extent of burns was 1.0% total body surface area (range, 0.05%-10%). We found an association between age and burn etiology and age and burn site. A high number of patients with injuries in the lower extremity sought medical care after day 1 but before day 4 postinjury. Delayed admission was found to be an important factor causing an increase in complication frequency.

CONCLUSIONS: There are many factors associated with age that affect the incidence and outcomes of burn injuries. Risk factors leading to burns are preventable, and the physical and psychological consequences of people who survive burn injuries can be life-threatening and often devastating. The best way to treat a burn is to prevent it from happening in the first place.

KEY WORDS: *Burn injuries, Clinical profile, Complications, Diabetes mellitus, Hyperglycemia*

INTRODUCTION

The incidence of diabetes is rising at an alarming rate, with diabetes becoming one of the most common premorbid conditions affecting all ages. The International Diabetes Federation reported that, in 2021, 537 million adults aged 20 to 79 years were living with diabetes and predicted that it would affect 643 million people by 2030 and 783 million people by 2045. The International Diabetes Federation also revealed that more than 3 of 4 adults with diabetes live in low- and middle-income countries.[1] Burn injuries are also a leading cause of morbidity and disability, and even though burns can happen anywhere, anytime, to anyone[2] the burden of trauma is disproportionately higher in those who live in low- and middle-income countries compared with high-income countries.[3]

The 2 conditions of diabetes and burns frequently occur simultaneously or cause one another. Burn injuries can induce acute stress hyperglycemia, which increases morbidity and mortality.[4] Diabetes mellitus is one of the most important independent risk factor causing poor outcomes in patients with burn injuries.[5] Identifying the features of the problem will help to improve prevention efforts to

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increase awareness about burn hazards and subsequently reduce the incidence and severity of burn injuries in this special subpopulation. In this study, we thus aimed to determine the demographic characteristics, clinical presentation, and outcomes of burn patients with preexisting diabetes mellitus who were seen over the previous 5 years at a single burn center.

MATERIALS AND METHODS

A retrospective study was conducted at the Baskent University Burn Center and included all burn patients ≥18 years of age who had an ICD-10 record of diabetes or its associated complications and who were discharged with the recommendation to follow-up at least once within 1 month. Patients were seen at the burn center from September 1, 2018, to September 1, 2022. Wounds other than burns and people with incomplete and inconsistent data were excluded. Our study was conducted in accordance with the principles of the Helsinki Declaration.

We collected demographics and relevant clinical data from medical records. Patients were then evaluated in subgroups according to age (18-49 y, 50-64 y, and ≥65 y) and time interval between occurrence of injury and admission to a medical center.

We used IBM SPSS version 25.0 for Windows for data management and analyses. Normally distributed numeric data are shown as the mean ± SD, and nonnormally distributed numeric data are shown as median (minimum to maximum). We analyzed relationships among the investigated variables using a chi-square test with Monte Carlo correction. $P < 0.05$ was considered significant with a confidence interval of 95% and a 5% margin of error.

RESULTS

Of 90 patients with diabetes admitted to our burn center over the 5-year study period, 52 met the inclusion criteria. In the study group, 53.8% were women and male-to-female ratio was 0.86:1. Mean age of the study group was 62.7 ± 12.4 years (range, 33-85 y). Only 1 patient had past medical history of burns, and 4 had previous history of traumatic wounds other than burns. Scalding was the most common cause of burn injury (50%), followed by contact burns (Figure 1). A total of 32.7% of the patients had burns affecting their hands, either as part of a more extensive burn or as an isolated injury (Figure 2). The majority of the patients had second-degree (partial thickness) burns. The median extent of burns was 1.0% total body surface area (range, 0.05%-10%). Table 1 shows the main characteristics of the study population.

The median time to seeking burn care after the injury was sustained was 1.50 days (range, 0-35 days). In terms of preadmission interventions, 13 of 52 patients (25%) received treatment before coming to our center. At admission, glucose level was measured in 49 patients (94.2%), with hyperglycemia shown in 32 patients, representing 61.5% of the total study population (Figure 3). We identified 10 patients (19.2%) admitted for in-hospital treatment with a median length of hospital stay of 8 (range 0-73) days (Table 2). A total of 15 patients were taken to the operating room for surgical treatment. The mean number of surgical interventions required per patient was 1.5. We identified 2

FIGURE 1. Cause of Burns in the Total Study Population

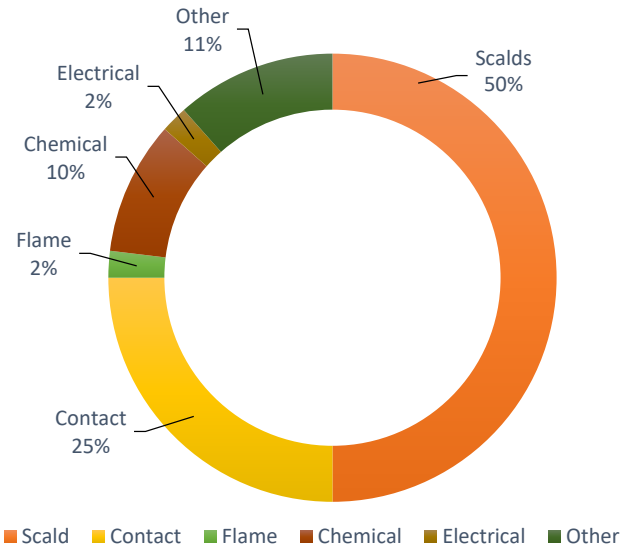
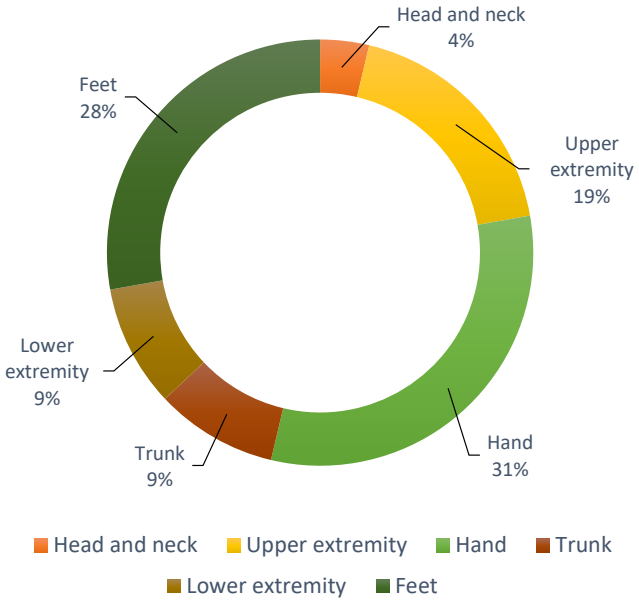


FIGURE 2. Site of Burn in the Total Study Population



patients who required a maximum of 5 surgical interventions, and also 2 patients who underwent amputation. The most common surgical procedure performed was surgical debridement followed by flap surgery in 4 cases.

Only 5 patients (9.6%) developed burn-related complications while being treated in the hospital. The most frequent complication was bacterial burn wound infection, occurring in 3 patients, and *Pseudomonas aeruginosa* was the most common pathogen involved. Of those patients who developed complications, the minimum length of hospital stay was 2 days and the maximum was 73 days. Of 52 patients, 48 patients (92.3%) were uneventfully discharged home. However, 34.6% missed their follow-up appointment.

We evaluated the data according to the time interval from injury to admission to our center and found an association between the development of complications and those patients who were admitted more than 4 days after injury. We also found that patients with injury in the lower extremities (excluding feet) were admitted to our burn center within days 1 to 4 postinjury.

We also evaluated patients according to their age groups and found that 51.9% of the total study group were aged 65 years or older. Significant differences were found regarding burn etiology and burn site between the age groups (Figure 4 and Figure 5). We observed that patients aged ≥65 years were more likely to experience contact burns, with the feet being the most affected body site. In contrast, younger patients were more likely to have scalds, with their hands being the most affected body site. Trunk burns were similar among age groups. There was no significant difference in development of complication or outcomes between the 3 age groups.

TABLE 1. Sociodemographic Characteristics and Burn Clinical Patterns

Variable	Value
Age, mean ± SD years	62.7 ± 12.4
Age group, No. (%)	
18-49 years	10 (19.2%)
50-64 years	15 (28.9%)
≥65 years	27 (51.9%)
Sex, No. (%)	
Female	28 (53.8%)
Male	24 (46.2%)
Total body surface area, median (range) %	1.0 (0.05-10)
Time to seeking care after injury, median (range) days	1.50 (0-35)

TABLE 2. Hospital Stay and Burn Treatment

Variable	Value
No. (%) of patients admitted for in-hospital treatment	10 (19.2%)
No. (%) of hospitalized patients with burn-related complications	5 (50%)
Length of hospital stay, median days (range)	8 (0-73)
Surgical interventions required per patient, mean ± SD	1.5 ± 1.9

DISCUSSION

Burn injuries and diabetes are both multisystemic problems. Burn patients with diabetes have a particular clinical profile, as they are predisposed to foot burns and prolonged healing time.[5,6] Our findings emphasize the other important risk factors; that is, the most affected population was aged 65 years and older. This finding is similar to previous reports that have identified older patients as the most vulnerable to risks of morbidity and mortality after burn injury, with an increased risk for adverse outcomes.[7-9] We also found that the major mechanism of injury was scalding, and the most common area injured were the hands, either as part of a more extensive burn or as an isolated injury. These findings are similar to previous reports.[8,10] As the population ages, a rise in the number of burn-related accidents is expected. Additionally, both aging and diabetes have been associated with visual impairment, limited mobility, and reduced reaction time, which may predispose older adults to burns.[5,10]

Diabetic neuropathy leads to burns with poor outcomes because of prolonged exposure to the stimulus without appropriate neurological feedback, which results in deeper burns, especially in the limbs. The burn patients with

FIGURE 3. Glucose Level at Admission in the Total Study Population

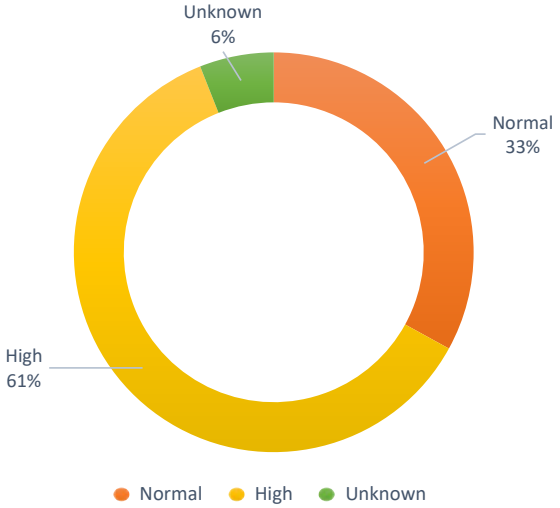


FIGURE 4. Cause of Burn in Different Age Groups in the Study Population

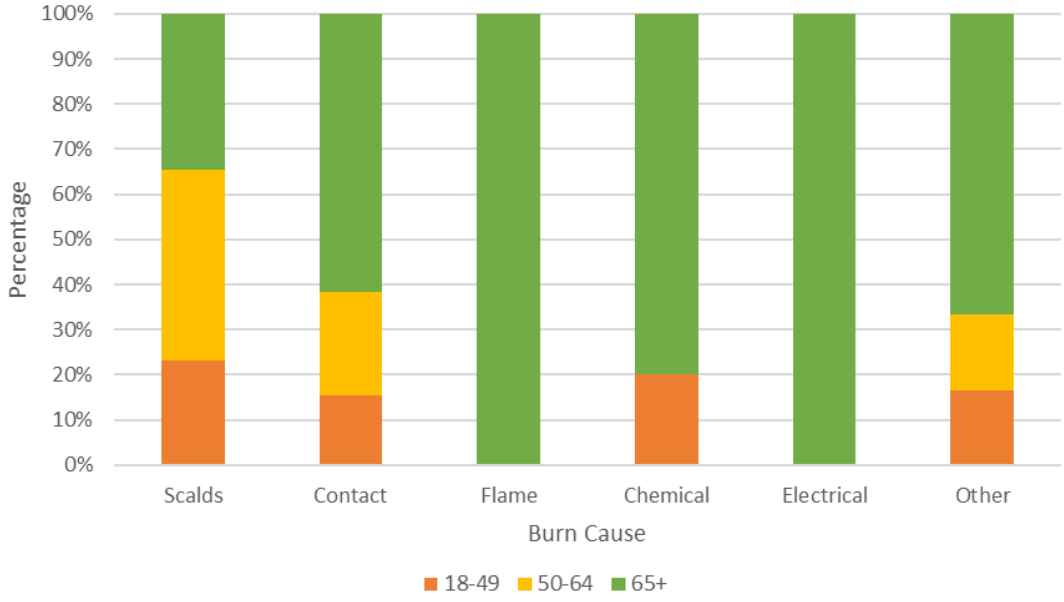
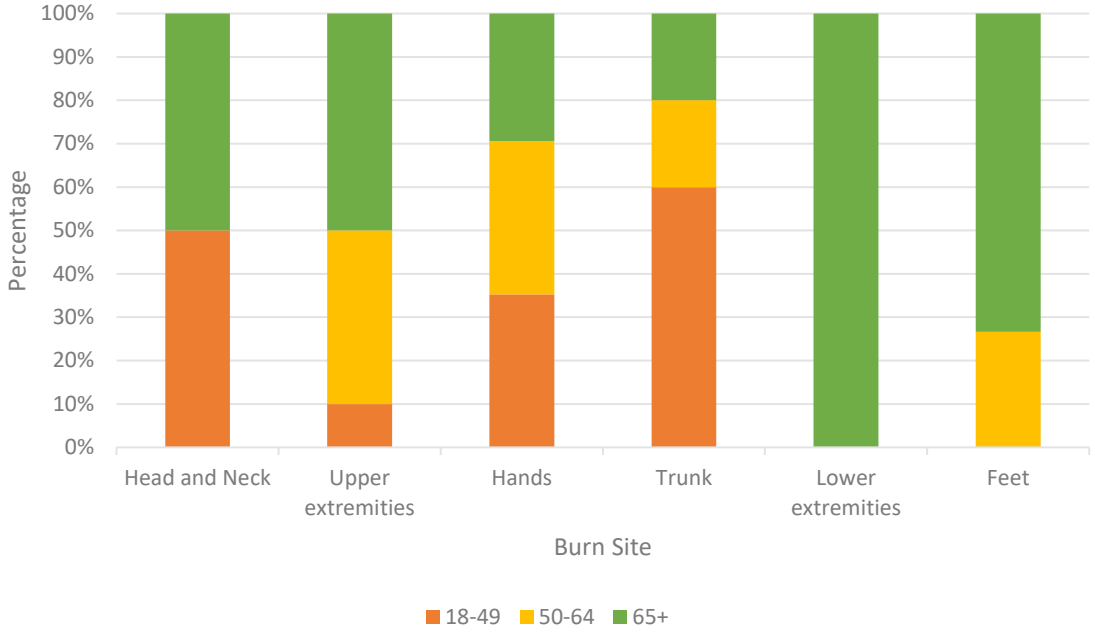


FIGURE 5. Site of Burn Injury in Different Age Groups in the Study Population



diabetes require special attention and meticulous monitoring. In addition, both the presence of peripheral vascular disease and endothelial dysfunction are frequent in people with diabetes, and these limit vasodilatation to conduct heat, aggravating the thermal insult.[10] Hypoesthesia has been shown to be an important risk factor for burns, even more than motor impairment.[11] Patients with diabetes have an altered pain threshold and tolerance; therefore, they may have either a delay in recognizing the extent of the injury or a delay in presentation.[12] These factors may explain the association that we found between the development of complications and those patients admitted on or after day 4 after the burn injury, especially in those with injuries located in the limbs.

The median total body surface area involved among our patients was much lower than that reported in some other studies.[5,6] This could explain the reason for the lower mortality and infection rates in our patients compared with other studies; however, we do not consider these differences in total body surface area relevant because of the characteristics of this special population of patients with

diabetes, in which a small injury could easily become a big problem.

Burn patients with diabetes have many risk factors that can complicate the treatment, such as a delay seeking treatment, effects of diabetes, associated morbidities, and complications related to the burn injury site. Diabetes, especially when persistently uncontrolled, can lead to impairment of a large spectrum of biological mechanisms involved in the tissue repair process, such as a reduction in the inflammatory response, angiogenesis, and collagen synthesis; it also alters the fibroblast proliferation, granulocyte function, and capillaries. Finally, hyperglycemia, insulin resistance, obesity, and diabetic nephropathy all contribute significantly and independently to an impaired wound healing process.[13,14] Although there is controversy with regard to insulin therapy and tight glycemic control in burn patients, several studies have shown how controlling hyperglycemia in both patients with diabetes and patients without diabetes improves morbidity and mortality.[7,8] More than 60% of our study population was hyperglycemic at admission. Postburn hyperglycemia could be persistent for up to 6 weeks, with insulin resistance for up to 3 years[15]; however, there is no study evaluating how these changes affect patients with diabetes and their antidiabetic therapy in the long term.

This study confirmed previous results stating that burn patients with diabetes have a higher risk for complications and need more surgical procedures (including amputations) compared with patients without diabetes.[13,14,16] Although we found that 19.2% of our patients were admitted for in-hospital treatment (Table 2), this rate was higher compared with a previous report from the United States.[17] This difference may be because our study included the acute burn cases but not those with chronic wounds. However, burn patients with diabetes have an increased hospital admission rates and prolonged length of hospital stay; even in our study, which included acute burn cases, the median length of hospital stay was 8 days (range 0-73 days); however, the literature has shown mixed results.[5,16,18-20]

Most patients in our study were discharged under stable conditions; however, we found a high no-show rate for follow-up visits (34.6%). The prevalence of no-shows at diabetes clinics varies worldwide, ranging from 4% to 64%,[21,22] and many burn patients struggle to attend follow-up visits after discharge and miss their appointments.[23] It is crucial to identify the factors associated with the poor compliance to outpatient clinic attendance in order to develop early intervention strategies after a first missed appointment and maximize the outcomes in these patients.

The results of our study must be considered in the context of its limitations. The generalization of the findings to other settings should be considered with caution because of its retrospective nature, chart review, strict inclusion criteria, single-center, and hospital-based investigation. The changes in treatment of burn patients and the increase in the implementation of standardized protocols over the 5-year period might have influenced the values for glycemic control.

CONCLUSIONS

Our results suggest that burn patients with diabetes tend to be older and present in a delayed manner with injuries predominantly affecting the limbs; the particularities of different age groups must be taken into account. There are many factors associated with age that affect the incidence and outcomes of burn injuries.

We recommend limiting the use of blood glucose as a surrogate for altered glucose homeostasis since it does not reveal the whole complex metabolic picture of these patients. It is necessary to conduct more studies to learn about changes in the postburn hypermetabolic state recovery phase and those secondary to postseptic metabolic derangement, since both of these conditions lead to hyperglycemia.

Burns injuries can be preventable. The physical and psychological consequences in patients who survive burn injuries can be life-threatening and many times devastating. The best way to treat a burn is to prevent it from happening in the first place; thus, the implementation of prevention and training programs for health care professionals and patients with diabetes are highly needed since these programs could have a favorable effect on morbidity and mortality.

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