Submitted: 06 January, 2024 Accepted: 12 March, 2024 Published: 08 September, 2024 DOI:10.22514/sv.2024.114

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Signa Vitae

ORIGINAL RESEARCH

Inpatient falls in burn units

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Abstract

Inpatient falls are one of the most frequently reported adverse events. Existing literature describes both prediction and prevention strategies for falls but not specifically for burn patients. Severe burns are associated with a high mortality rate and significant mobility impairment. Pain, itching and dressings may influence the rate of falls among burn patients. We conducted a retrospective multicenter study enrolling a total of 494 patients. The burn patients who fell had a longer length of stay (LOS) ($p < 0.05$, odds ratio (OR) = 1.01). Patients who fell also more frequently had burns located on the head and neck ($p = 0.001$, OR = 6.33) or on the trunk ($p = 0.01$, OR = 4.71). Falls did not influence overall survival rates. Visual impairment due to facial burns and dressings may be associated with a higher incidence of falls. More studies of burn patients should be performed to evaluate additional risk factors and develop preventive and educational programs.

Keywords

Inpatient fall; Burn; Adverse event

1. Introduction

Inpatient falls are one of the most frequently reported adverse events [1]. A fall is defined as an "unexpected event in which the participant comes to rest on the ground, floor or lower level" [2]. Inpatient falls are a potential source of serious complications, especially among older people [3, 4]. The most crucial fall risk factors are delirium, anxiolytics, fall history, muscle weakness [3–5], mobility disorders and visual impairment [6]. Existing literature describes both prediction and prevention strategies for falls but not specifically for burn patients.

Burns are a global public health concern. The incidence of burns is fourth among all injuries, behind traffic accidents, falls and interpersonal violence [7, 8]. In 2019, 8,378,122 new burn cases were reported globally, and 111,292 burns were lethal [9]. "Thermal burns are skin injuries caused by excessive heat, typically from contact with hot surfaces, hot liquids, steam or flame" [10]. The severity of a burn is associated with the extent of the affected skin as well as the depth of the affected skin and underlying tissue [11]. Treatment of moderate or severe burns requires a multidisciplinary approach. Major burn injury results in a burn shock and pathophysiological changes in all organs. Burns extending over 25–30% of the total body surface area (TBSA) invariably result in the severe malfunction of the cardiovascular system, impair tissue microcirculatory perfusion, and manifest as hypovolemic shock. Systemic inflammatory response syndrome (SIRS) is triggered by the release of cytokines from the skin's innate immune system and may lead to multiorgan dysfunction syndrome (MODS) and early death. Enhanced secretion of catecholamines, dopamine, glucagon and glucocorticoids is associated with the consecutive catabolic state leading to skeletal muscle wasting [11, 12]. Catabolic losses in lean body mass (LBM) correlate with increased morbidity and mortality. Early surgical intervention and eschar removal decrease mortality by reducing bleeding [13, 14], infection risk [15], and energy demand [16], but multiple surgical procedures involve the accumulation of opioids and other sedative and analgetic drugs. Burn patients require systemic dressing changes, and the dressing may impair mobility. All these factors may influence the risk of accidental falls among hospitalized patients in burn units. Given the contribution of the risk factors described above to fall predisposition, the aim of this study was to describe the epidemiology of inpatient fall risks in burn units.

2. Materials and methods

2.1 Study design and patient population

This was a retrospective multicenter study conducted at the Malopolska Burn and Plastic Surgery Center (MBPSC) of the Ludwik Rydygier Memorial Hospital in Kraków, Poland, and the East Centre of Burns Treatment and Reconstructive Surgery (ECBTRS), Łęczna, Poland. A total of 494 patients admitted to both burn units from August 2019 to December 2021 were enrolled in the study. The inclusion criteria included

age older than 18 and an injury involving a thermal or chemical burn. The exclusion criteria were electrical burns, frosts and age under 18. Clinical and demographic data were assembled upon admission to a burn unit. We collected the following information at enrollment: age, sex, percentage and depth of burn, localization of burn, mechanism of burn trauma, length of stay (LOS) and history of falls.

2.2 Statistical analysis

The materials were retrospectively retrieved from the adverse events database of the burn units of Malopolska Burn and Plastic Surgery Center (MBPSC) and East Center of Burns Treatment and Reconstructive Surgery (ECBTRS). The statistical analysis was performed with Statistica version 13.1 (StatSoft Polska, Krakow, Poland). A 5% margin of error was applied, and values of $p < 0.05$ were considered statistically significant. The Shapiro-Wilk test was used to examine distributions of variables. The data collected during the study were summarized with a descriptive analysis. Quantitative data were presented using the mean, standard deviation, and minimum and maximum values. Discordant variables were compared using the Mann-Whitney test for independent samples, and linear regression was used to evaluate the influence of the variables. The relationships between the variables were investigated using Spearman's correlation.

3. Results

There were 494 patients enrolled in the study: 354 male and 140 female. The mean age was 50.45 years (range 18–92, standard deviation (SD) 17.79). The mean extent of the burn was 15.29% (range 1–98%, SD 16.05). The mean LOS was 27 days (range 1–292, SD 26.3). The observed mortality was 0%.

Of all patients, 88% had deep burns (deep dermal and/or full thickness burns). Most burns were on an upper extremity (33%) or lower extremity (30%), with fewer on the head and neck (15%) or trunk (13%). Table 1 presents characteristics of the groups, differentiated by the incidence of a fall.

Our study showed that the fall rate in the burn units was 2.02%. Burn patients with a fall had a longer LOS ($p < 0.05$, OR = 1.01; Fig. 1).

The mean day of the fall was 31 (range 5–85, SD 28.7). In one case, two falls were recorded. Experiencing a fall did not influence treatment of the burn wound, either surgical or conservative, nor did it worsen the wound depth. Patients who fell more frequently had burns located on the head and neck ($p = 0.001$, OR = 6.33) or on the trunk ($p = 0.01$, OR = 4.71). Patients with falls had a larger extent of burns ($p = 0.03$; Fig. 2). The differences in age and extent of the burn between the subgroups were not statistically significant.

The length of hospitalization correlated with the depth of the burn and with having a burn in multiple locations.

4. Discussion

Falls are adverse events that remain a problem in healthcare settings worldwide. The incidence of falls, which is usually expressed per 1000 bed days, usually ranges from 2–8 in acute hospitals, geriatric wards, and emergency departments [17]. In our study, we showed that longer patient hospitalization time was a strong risk factor for a patient fall in burn units. This observation is consistent with the results reported by Hill *et al.* [18, 19] and our previous study. The risk of inpatient falls was positively correlated with the LOS and increased significantly from the 11th day of hospitalization. There was a weak influence of the extent of the burn on inpatient fall risk. The LOS did not correlate with the extent of the burn but did correlate with the depth of the burn and having a burn

TABLE 1. Characteristics of the study group.

	Fall	No Fall	*p*-value	95% CI (lower–upper)
Number (N)	10	484		
Sex (M/F)	7/3	347/137	0.910	0.43–0.48
Days of hospitalization	mean 63 median 33 (range 9–292, SD 82.97)	mean 26 median 19 (range 1–166, SD 23.46)	0.020	24.74–28.02
Mean age	60.8 (range 20–82, SD 19.83)	50.2 (range 19–92, SD 17.7)	0.070	16.90–19.14
Deep burn (%)	90%	87%	0.800	0.33–0.37
Mechanism of burn	thermal 100%	thermal 96%		
Location of burn (%)				
Head	50%	14%	0.001	0.33–0.38
Trunk	40%	12%	0.009	0.31–0.36
Lower extremity	40%	30%	0.990	0.44–0.50
Upper extremity	60%	33%	0.070	0.43–0.49
Extent of burn (%)	21% (range 5–65%, SD 16.74)	15% (range 1–98%, SD 16.03)	0.030	15.34–17.39

CI: confidence interval; M/F: male/female; SD: standard deviation.

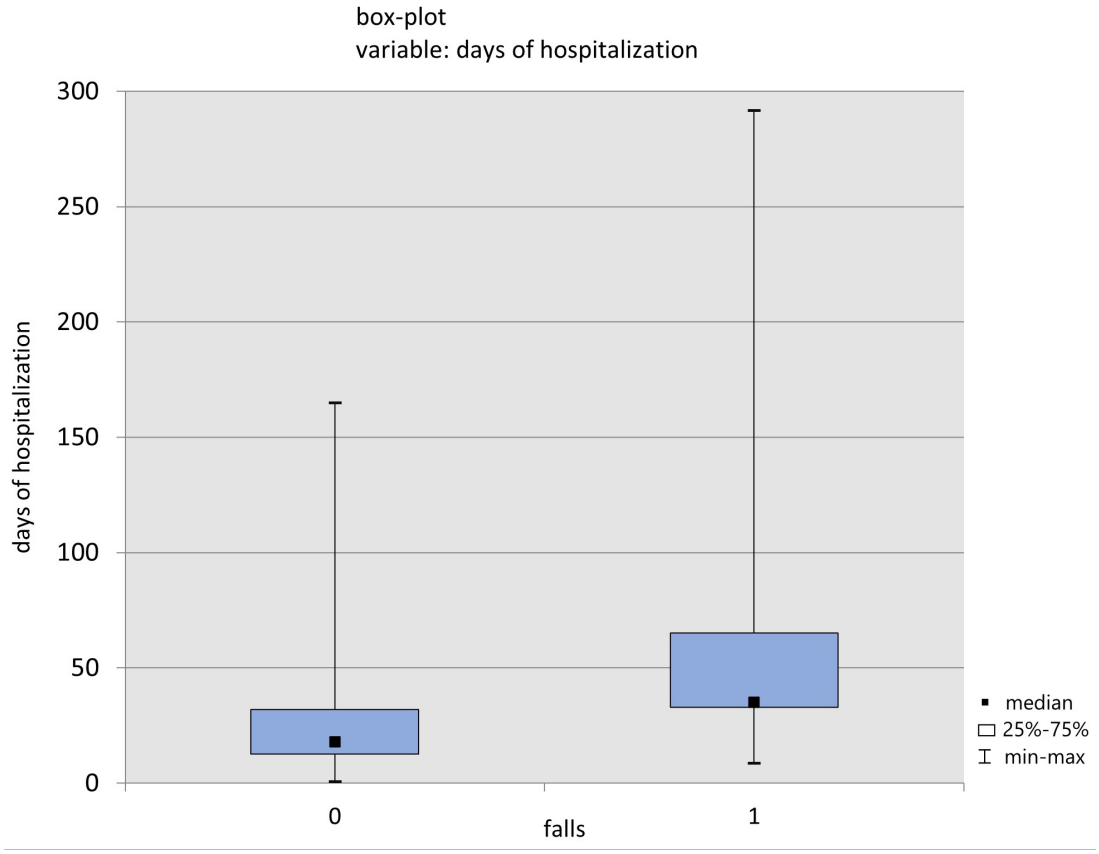

FIGURE 1. Number of days of hospitalization for patients without a fall (0) and those who experienced a fall (1).

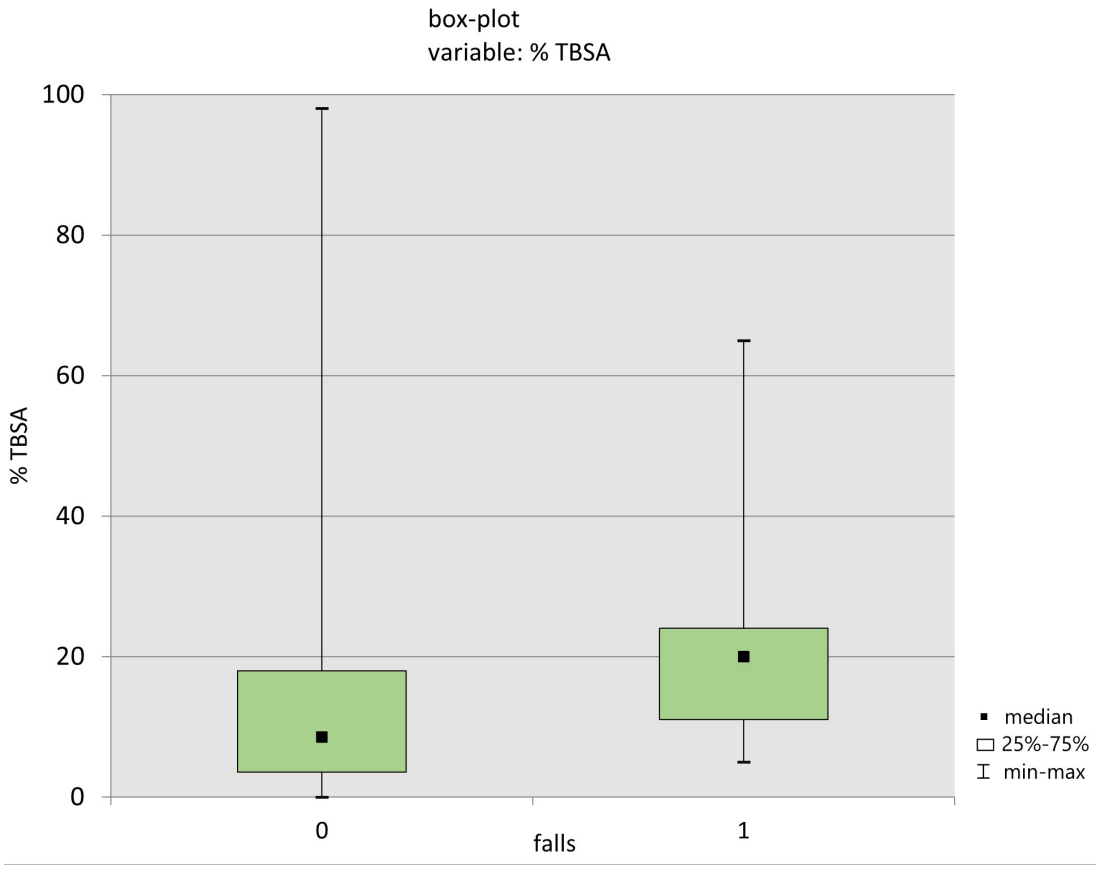

FIGURE 2. Extent of the burn for patients without a fall (0) and those who experienced a fall (1). TBSA: total body surface area.

in multiple locations. Head dressings may impair vision and predispose patients to falls. In addition, eyelid and periocular involvement, which affects the field of view, is common in facial burns [20].

Our study showed that the fall rate in the burn units was 2.02%. The fall rate in critical care has been reported as low (0.99 falls/1000 bed days) [21]. In intensive care units, which have similar care and equipment as burn units, the risk of inpatient falls increases 9.9 times if the length of hospitalization exceeds 19 days [22]. Therefore, there are differences in the number of falls observed in different types of hospital wards.

The experiences of surgical departments show that the average fall rates per month of an inpatient medical/surgical unit can be reduced by 44.5% if education of medical personnel is implemented [1]. Physical rehabilitation and education prevent falls and fainting after long-term immobilization in burn units and are components of multidisciplinary care. Early rehabilitation is the key to preventing contractures or muscle weakness in patients with burns [23]. An important basic difference between burn patients and patients from other wards is the long-term presence of large dressings that often cover more than the half of the body, which further limits a patient's mobility. As an example, a deep burn covering 20% of TBSA that required a skin graft to cover the wound after the excision of burn necrosis involves an additional wound in the donor skin area equating to at least 7–15% of TBSA. Large dressings and painful body parts, especially in donor skin graft areas, intensify the difficulties of rehabilitation.

From the moment of admission to the burn center, patients undergo a comprehensive evaluation by physiotherapists that involves the development of a care plan appropriate for the surgical treatment and general condition at individual stages of management. Positioning programs should begin immediately upon admission to the burn center and continue throughout the overall treatment period [24]. The rehabilitation of conscious patients includes education on upright positioning. This applies primarily to patients who have undergone long periods of immobilization in bed or those with a history of intubation and sedation and can prevent falls during the patients' first activities while losing muscle mass and having bandages that limit movement.

Although survival rates for patients after burn trauma have increased over the years, psychological problems are still a challenge of multidisciplinary treatment [25]. One-third of patients develop post-traumatic stress disorder (PTSD), and some patients develop acute stress disorder [26]. People with PTSD have intense, disturbing thoughts and feelings related to their experience that last long after the traumatic event has ended [25]. Exclusion from work, stress related to family, long hospitalization periods, and fear of post-burn scars may aggravate emotional problems. In addition, rehabilitation can cause physical pain despite the use of analgesic drugs. Anxiolytics and delirium are strong individual risk factors for inpatient falls [4]. Pain and itching of burn wounds also increase the risk [1]. All these factors put burn patients at an especially high risk of falls.

The mean age of patients who fell was 60.8 (range 20–82, SD 19.83). According to our results, the highest fall risk was in the group of patients over 60 years of age. This is consistent with other research findings on populations of non-burn patients [1]. One meta-analysis reported that falls in older surgical patients were a quite prevalent public health problem. Age is also a strong prognostic factor for burns, and older patients with burns have higher mortality risk [27].

Our results showed that patients with burn injuries on the head and neck were at a higher risk of a fall. This might be due to extensive dressings that might limit their field of view. Visual impairment is one of the individual risk factors for inpatient falls in the general population [4].

In our study, we analyzed the epidemiology of falls in burn units. To our knowledge, this is one of the first studies to characterize fall risk among burn patients. Our study had limitations resulting from its retrospective nature, limited number of centers, and small sample size. A thorough multicenter study examining the impacts of all comorbidities and medications on fall risk would be valuable. Additionally, in the future, we plan to use prediction scales like the STRATIFY score [6] or the Morse Fall Scale (MFS) [27] as tools for prospectively predicting falls in burn patients.

5. Conclusions

Inpatient falls in burn units were rare but could complicate the course of hospitalization. Falls were associated with longer hospital stays. In addition, visual impairment due to facial burns and dressings may be associated with a higher incidence of falls. More studies of burn patients should be performed to evaluate additional risk factors and develop preventive and educational programs.

AVAILABILITY OF DATA AND MATERIALS

Availability of data and material available in East Center of Burns Treatment and Reconstructive Surgery, Leczna, Medical University of Lublin, or by the corresponding author: t.korzeniowski@gmail.com.

AUTHOR CONTRIBUTIONS

AC and MM—conceptualization; methodology; AS and TK—software; validation; AC, IG, JP—investigation; resources; MM and IG—data curation; AC, MM, AS—writing-original draft preparation; AS, TK, JS—writing-review and editing; AS, JS—visualization; AC, AS, TK, JS—supervision; JP, AS and TK—project administration; AC—funding acquisition. All authors have read and agreed to the published version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The principles outlined in the Declaration of Helsinki were respected. The study received approval by the Institutional Ethics Committee of the Independent Public District Hospital in Leczna (No. WLNZ/NoZ/1/2020). Consent has been received as a part of the research project "Interdisciplinary

aspects of the problem of falls in patients in the healthcare system in Poland".

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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How to cite this article: Anna Chrapusta, Marcin Mikos, Agnieszka Surowiecka, Iwona Grzelak, Joanna Piszczek, Tomasz Korzeniowski, *et al*. Inpatient falls in burn units. Signa Vitae. 2024; 20(9): 79-83. doi: 10.22514/sv.2024.114.