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Research Article

Clinical characteristics and outcomes of patients hospitalized with electrical burns: A retrospective cohort study

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ABSTRACT

Objective: This study evaluated the demographic and clinical characteristics of patients hospitalized for electrical burns and examined factors associated with voltage level, burn depth, and clinical outcomes.

Methods: This retrospective descriptive study included 51 patients hospitalized for electrical burns from January 1, 2020, to August 1, 2024. We analyzed demographic data, injury mechanism, voltage level, burn depth, total body surface area (TBSA), Abbreviated Burn Severity Index (ABSI) score, hospital and intensive care unit (ICU) lengths of stay, surgical intervention, amputation, complications, and in-hospital mortality.

Results: The median age was 36 years (interquartile range [IQR], 20–44), and 90.2% of patients were male. High-voltage injuries comprised 58.8% of cases. The median TBSA was 18% (IQR, 10–30), and the median ABSI score was 5 (IQR, 4–6). Surgical intervention was performed in 84.3% of patients. Amputation, complications, and in-hospital mortality occurred in 29.4%, 64.7%, and 3.9% of patients, respectively. Compared to the low-voltage group, high-voltage injuries were associated with significantly longer hospital and ICU stays, greater TBSA involvement, higher ABSI scores, and increased rates of fourth-degree burns, amputation, and complications (all $p < 0.05$).

Conclusion: High-voltage electrical burns were associated with greater burn extent, higher ABSI scores, longer hospital and ICU stays, and higher rates of surgical intervention, amputation, and complications. These findings indicate greater clinical severity in high-voltage electrical injuries.

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1. Introduction

The widespread use of electricity in daily life and industry has made electrical burns a significant public health concern [1]. Although they account for less than 5% of burn center admissions worldwide, electrical burns are among the most severe due to high morbidity

and mortality rates [2]. Understanding their epidemiological features is essential for prevention and improved outcomes. Electrical burns most often result from faulty installations, contact with electrical cables or high-voltage power lines, and lightning strikes [1,2]. Injuries may occur through direct current passage, exposure to heat from an electrical arc (arc flash), or flame burns from ig-

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nited clothing [3]. As a result, electrical burns range from superficial skin injuries to limb loss, permanent neurological damage, cardiac arrhythmias, and multiple organ failure [4–6].

Several prognostic scoring systems have been developed to predict outcomes, guide treatment decisions, and estimate mortality risk in patients with burn injuries. Among these, the Abbreviated Burn Severity Index (ABSI) is one of the most widely used. It incorporates five parameters: age, sex, presence of inhalation injury, full-thickness burns, and total body surface area (TBSA) burned [6]. Higher ABSI scores have consistently been associated with increased mortality risk and reduced survival probability [7].

Electrical burns differ significantly from other burn injuries in mechanisms, clinical presentation, and outcomes. Epidemiological and clinical outcomes vary by region, patient population, and healthcare system, underscoring the need for current, center-specific data. However, contemporary regional data on the clinical characteristics and outcomes of hospitalized patients with electrical burns, particularly comparisons between high- and low-voltage injuries, remain limited. Comprehensive evaluation of burn depth, TBSA, ABSI score, surgical intervention, amputation, complications, and mortality may provide a clearer characterization of injury severity and clinical course in this population. The present study aimed to evaluate the demographic, clinical, and injury characteristics, as well as treatment outcomes, of patients hospitalized with electrical burns at a tertiary burn center, and to compare the clinical characteristics and outcomes of high- and low-voltage electrical injuries.

2. Materials and Methods

2.1. Study design and patient population

This retrospective study was conducted at the burn center of a tertiary care teaching and research hospital. Ethical approval was obtained from the Samsun University Clinical Research Ethics Committee (Approval No. GOKAEK 2024/14/14; Date: August 14, 2024). Pediatric and adult patients hospitalized for the treatment of electrical burns between January 1, 2020, and August 1, 2024, were eligible for inclusion.

2.2. Inclusion criteria

Patients were included if they met all of the following criteria:

- Hospitalization at the burn center with a diagnosis of electrical burn during the study period;
- Availability of complete demographic and clinical data in the medical records; and
- Completion of treatment and follow-up at our institution.

2.3. Exclusion criteria

Patients were excluded if they:

- Were managed on an outpatient basis;

- Had incomplete medical records; or
- Had multiple hospital admissions related to the same injury, in which case only the first admission was included in the analysis.

A total of 51 patients met the eligibility criteria and were included in the study.

2.4. Data collection

Potentially eligible patients were identified through the electronic hospital information system by screening the records of patients hospitalized and treated at our burn center using the International Classification of Diseases, 10th Revision (ICD-10) codes W85 (exposure to electric transmission lines), W86 (exposure to other specified electric current), and W87 (exposure to unspecified electric current) during the study period. Eligibility was subsequently confirmed by reviewing electronic medical records in accordance with the predefined inclusion and exclusion criteria. A total of 57 hospitalized patients were initially identified. Of these, six patients were excluded: one patient was transferred to another center before completion of treatment, and five patients had insufficient medical records. Thus, the final study cohort consisted of 51 patients. Patient data were retrospectively retrieved from the electronic hospital information system and medical records. The following variables were recorded: age, sex, occupational injury status, mechanism of injury, location of exposure, voltage category, burn depth, total body surface area (TBSA), Abbreviated Burn Severity Index (ABSI) score, length of hospital stay, length of intensive care unit (ICU) stay, requirement for surgical intervention, amputation status, occurrence of complications, burn severity, and in-hospital mortality. Recorded complications included psychiatric complications, neurological or nerve injury, musculoskeletal injury, renal injury, compartment syndrome, cardiac injury, shock, fractures, pulmonary injury, and other organ injuries. The single patient with a lightning injury was excluded from subgroup comparisons according to burn etiology because this category contained only one patient.

Electrical injuries were classified according to voltage level as low-voltage (<1,000 V) or high-voltage ($\geq$ 1,000 V), in accordance with previous reports [5]. Burn depth was categorized as second-, third-, or fourth-degree burns. TBSA and ABSI scores were obtained from the patients' medical records, and ABSI mortality risk categories were subsequently determined for all patients.

2.5. Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA) and Microsoft Excel 2024. Categorical variables are presented as frequencies (n) and percentages (%), whereas continuous variables are expressed as the median and interquartile range (IQR). The distribution of continuous variables was assessed both graphically and using the Shapiro–Wilk test. Categorical variables were compared using Pearson's chi-square test when the assumptions of the test were satisfied. Fisher's exact test was used for 2×2 contingency tables with

small expected cell counts, whereas the Fisher–Freeman–Halton exact test was used for larger contingency tables with sparse expected frequencies. Categorical data were presented as frequencies (*n*) and percentages (%). Continuous variables, including age, length of hospital stay, length of ICU stay, TBSA, and ABSI score, were compared between low- and high-voltage groups using the Mann–Whitney *U* test. Comparisons of continuous variables across three or more groups, including burn depth, amputation status, and burn etiology, were performed using the Kruskal–Wallis test. When statistically significant differences were identified among three or more groups, Bonferroni-adjusted post hoc analyses were conducted to determine pairwise group differences. A two-sided *p*-value < 0.05 was considered statistically significant.

3. Results

The median age of the 51 patients included in the study was 36 years (IQR, 20–44), and 90.2% were male. The median length of hospital stay was 29 days (IQR, 14–44), and the median length of intensive care unit (ICU) stay was 2 days (IQR, 0–8). Occupational injuries accounted for 29.4% of all cases. The most common cause of injury was indoor electrical accidents (43.1%), followed by occupational accidents (29.4%) and outdoor electrical accidents (25.5%). Injuries occurred outdoors in 51.0% of patients, and fourth-degree burns were identified in 45.1%. The median total body surface area (TBSA) burned was 18% (IQR, 10–30), and the median Abbreviated Burn Severity Index (ABSI) score was 5 (IQR, 4–6). Surgical intervention was performed in 84.3% of patients, whereas amputation, complications, and in-hospital mortality occurred in 29.4%, 64.7%, and 3.9% of patients, respectively (Table 1). Among the 43 patients who underwent surgical intervention, the most common procedures were debridement (*n* = 43), skin grafting (*n* = 38), amputation (*n* = 15), escharotomy/eschar excision (*n* = 11), and fasciotomy (*n* = 10). Some patients underwent multiple procedures during hospitalization. The most frequent complications were psychiatric complications and neurological or nerve injuries (*n* = 10 each), followed by musculoskeletal injury, renal injury, and compartment syndrome (*n* = 4 each). Some patients had more than one complication.

When patients were stratified according to voltage category, the high-voltage group demonstrated significantly longer hospital stays [41.5 (30–61) vs. 14 (5–26) days; *p* < 0.001], longer ICU stays [6 (2–9) vs. 0 (0–0) days; *p* < 0.001], greater TBSA involvement [22.5 (15–35) vs. 10 (5–20); *p* = 0.001], and higher ABSI scores [6 (5–7) vs. 4 (4–4); *p* < 0.001]. Occupational injuries, outdoor exposure, fourth-degree burns, the need for surgical intervention, amputation, and complications were all significantly more frequent in the high-voltage group (43.3% vs. 9.5%, *p* = 0.009; 76.7% vs. 14.3%, *p* < 0.001; 63.3% vs. 19.0%, *p* < 0.001; 100% vs. 61.9%, *p* < 0.001; 46.6% vs. 4.8%, *p* = 0.004; and 76.7% vs. 47.6%, *p* = 0.033, respectively) (Table 2, Fig. 1).

Table 1. Demographic and clinical characteristics of the patients.

	Total (<i>n</i> = 51)
Age (years) *	36.0 (20–44)
Sex **	
Female	5 (9.8)
Male	46 (90.2)
Length of hospital stay (days) *	29.0 (14–44)
ICU length of stay (days) *	2.0 (0–8)
Occupational injury **	
No	36 (70.6)
Yes	15 (29.4)
Cause of burn **	
Outdoor electrical accident	13 (25.5)
Indoor electrical accident	22 (43.1)
Occupational accident	15 (29.4)
Lightning	1 (2.0)
Location of injury **	
Outdoor	26 (51.0)
Indoor	25 (49.0)
Burn depth **	
Second-degree	7 (13.7)
Third-degree	21 (41.2)
Fourth-degree	23 (45.1)
TBSA (%) *	18.0 (10–30)
ABSI score *	5.0 (4–6)
ABSI mortality risk **	
Very low	4 (7.8)
Low	29 (56.9)
Moderate	11 (21.6)
High	6 (11.8)
Very high	1 (2.0)
Surgery **	
No	8 (15.7)
Yes	43 (84.3)
Major/minor amputation **	
No	36 (70.6)
Minor	10 (19.6)
Major	4 (7.8)
Minor+major	1 (2.0)
Mortality **	
Survive	49 (96.1)
Exitus	2 (3.9)
Complications **	
No	18 (35.3)
Yes	33 (64.7)
Voltage level **	
Low voltage	21 (41.2)
High voltage	30 (58.8)
Burn severity **	
Moderate	8 (15.7)
Major	43 (84.3)

* Median (IQR), ** *n* (%). TBSA, total body surface area; ABSI, Abbreviated Burn Severity Index; ICU, intensive care unit.

Table 2. Comparison of demographic and clinical characteristics according to voltage category.

	Low voltage (n = 21)	High voltage (n = 30)	p
Age (years) *	35 (20-41)	38 (20-45)	0.247
Length of hospital stay (days) *	14 (5-26)	41.5 (30-61)	< 0.001
ICU length of stay (days) *	0 (0-0)	6 (2-9)	< 0.001
Sex **			
Female	4 (19.0)	1 (3.3)	0.085
Male	17 (81.0)	29 (96.7)	
Occupational injury (yes) **	2 (9.5)	13 (43.3)	0.009
Cause of burn **			
Outdoor electrical accident	2 (9.5)	11 (36.7)	< 0.001
Indoor electrical accident	17 (81.0)	5 (16.7)	
Occupational accident	2 (9.5)	13 (43.3)	
Lightning	0 (0.0)	1 (3.3)	
Location of injury **			
Outdoor	3 (14.3)	23 (76.7)	< 0.001
Indoor	18 (85.7)	7 (23.3)	
TBSA (%) *	10 (5-20)	22.5 (15-35)	0.001
ABSI score *	4 (4-4)	6 (5-7)	< 0.001
Burn depth **			
Second-degree	7 (33.3)	0 (0.0)	< 0.001
Third-degree	10 (47.6)	11 (36.7)	
Fourth-degree	4 (19.0)	19 (63.3)	
Surgery (yes) **	13 (61.9)	30 (100.0)	< 0.001
ABSI mortality risk **			
Very low	4 (19.0)	0 (0.0)	< 0.001
Low	15 (71.4)	14 (46.7)	
Moderate	2 (9.5)	9 (30.0)	
High	0 (0.0)	6 (20.0)	
Very high	0 (0.0)	1 (3.3)	
Amputation **			
No	20 (95.2)	16 (53.3)	0.004
Minor	1 (4.8)	9 (30.0)	
Major	0 (0.0)	4 (13.3)	
Minor+major	0 (0.0)	1 (3.3)	
Complications (yes) **	10 (47.6)	23 (76.7)	0.033
Mortality (ex) **	0 (0.0)	2 (6.7)	0.341
Burn severity **			
Moderate	8 (38.1)	0 (0.0)	< 0.001
Major	13 (61.9)	30 (100.0)	

* Median (IQR), ** n (%). TBSA, total body surface area; ABSI, Abbreviated Burn Severity Index; ICU, intensive care unit.

When patients were compared according to burn depth, significant overall differences were observed among the groups in age ($p = 0.013$), length of hospital stay ($p < 0.001$), ICU length of stay ($p = 0.001$), TBSA ($p = 0.007$), and ABSI score ($p = 0.012$). Bonferroni-adjusted post hoc comparisons showed that patients with second-degree burns were significantly older than those with

third-degree burns. Length of hospital stay was significantly longer in both the third- and fourth-degree burn groups than in the second-degree burn group. ICU length of stay, TBSA, and ABSI score were significantly higher in the fourth-degree burn group than in the second-degree burn group. No other pairwise differences were statistically significant for these continuous variables (Table 3).

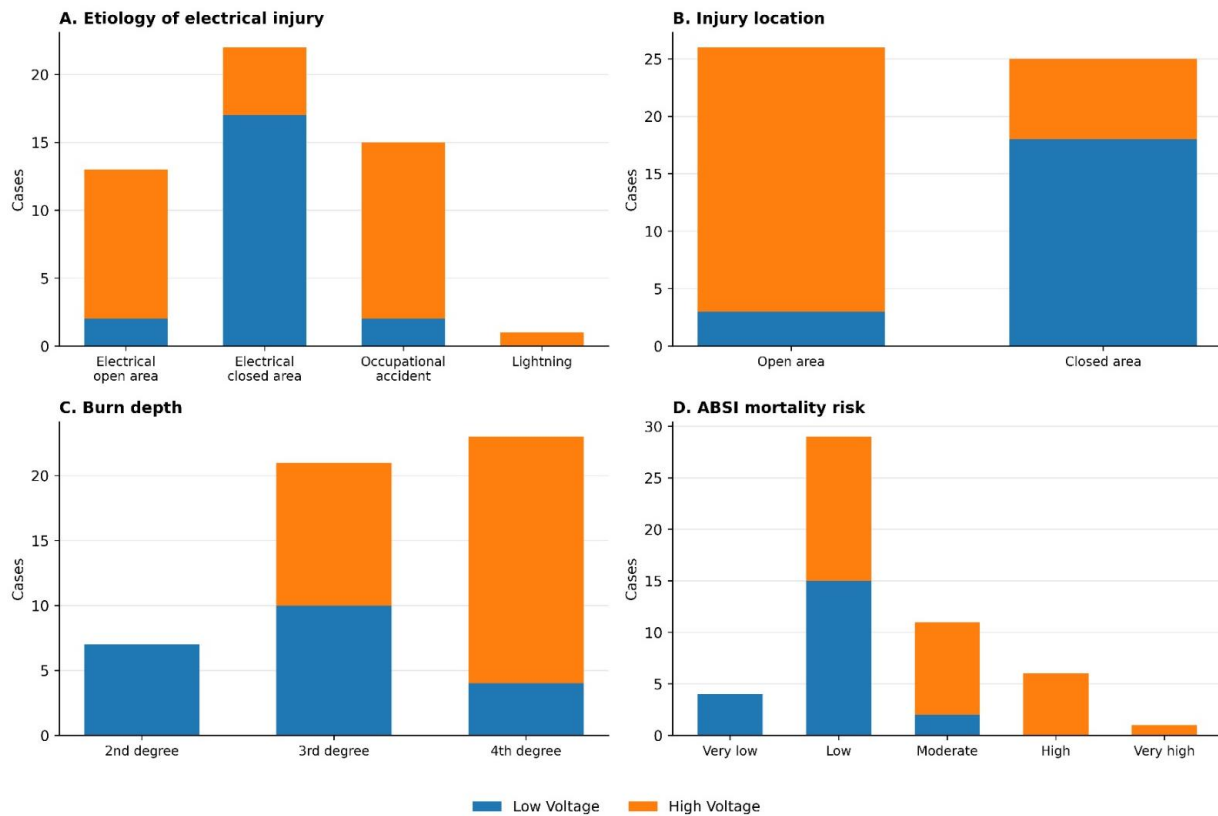


Fig. 1. Distribution of injury etiology, injury location, burn depth, and ABSI mortality risk categories among patients with low-voltage and high-voltage electrical injuries: (a) Etiology of electrical injury; (b) Injury location; (c) Burn depth; (d) ABSI mortality risk categories.

Table 3. Comparison of demographic and clinical characteristics by burn depth.

	2nd-degree (n = 7)	3rd-degree (n = 21)	4th-degree (n = 23)	p
Age (years) *	44 (36-48) ^a	27 (15-39) ^b	38 (28-49) ^{a,b}	0.013
Length of hospital stay (days) *	5 (3-7) ^a	29 (22-38) ^b	42 (20-63) ^b	< 0.001
ICU length of stay (days) *	0 (0-0) ^a	2 (0-5) ^{a,b}	6 (1-10) ^b	0.001
Sex **				
Female	0 (0.0)	4 (19.0)	1 (4.3)	0.133
Male	7 (100.0)	17 (81.0)	22 (95.7)	
Occupational injury (yes) **	1 (14.3)	6 (28.6)	8 (34.8)	0.548
Cause of burn **				
Outdoor electrical accident	0 (0.0)	4 (19.0)	9 (39.1)	0.049
Indoor electrical accident	6 (85.7)	11 (52.4)	5 (21.7)	
Occupational accident	1 (14.3)	6 (28.6)	8 (34.8)	
Lightning	0 (0.0)	0 (0.0)	1 (4.3)	
Location of injury **				
Outdoor	1 (14.3)	9 (42.9)	16 (69.6)	0.018
Indoor	6 (85.7)	12 (57.1)	7 (30.4)	
TBSA (%) *	5 (2-15) ^a	20 (15-25) ^{a,b}	25 (15-32) ^b	0.007
ABSI score *	4 (4-4) ^a	5 (4-5) ^{a,b}	6 (4-7) ^b	0.012
Surgery (yes) **	0 (0.0)	20 (95.2)	23 (100.0)	< 0.001
ABSI mortality risk **				
Very low	1 (14.3)	3 (14.3)	0 (0.0)	0.045
Low	5 (71.4)	14 (66.6)	10 (43.5)	
Moderate	1 (14.3)	1 (4.8)	9 (39.2)	
High	0 (0.0)	3 (14.3)	3 (13.0)	
Very high	0 (0.0)	0 (0.0)	1 (4.3)	

	2nd-degree (n = 7)	3rd-degree (n = 21)	4th-degree (n = 23)	p
Amputation **				
No	7 (100.0)	19 (90.5)	10 (43.5)	0.008
Minor	0 (0.0)	2 (9.5)	8 (34.8)	
Major	0 (0.0)	0 (0.0)	4 (17.4)	
Minor+major	0 (0.0)	0 (0.0)	1 (4.3)	
Complications (yes) **	4 (57.1)	11 (52.4)	18 (78.3)	0.173
Mortality (ex) **	0 (0.0)	0 (0.0)	2 (8.7)	0.193
Burn severity **				
Moderate	6 (85.7)	2 (9.5)	0 (0.0)	< 0.001
Major	1 (14.3)	19 (90.5)	23 (100.0)	

Superscript letters (^a, ^b) indicate the results of Bonferroni-adjusted post hoc pairwise comparisons. Groups without a common superscript letter differ significantly ($p < 0.05$), whereas groups sharing at least one letter do not differ significantly. * Median (IQR), ** n (%). TBSA, total body surface area; ABSI, Abbreviated Burn Severity Index; ICU, intensive care unit.

When patients were compared by amputation status, significant differences were observed among groups in length of hospital stay ($p = 0.021$), TBSA ($p = 0.042$), and ABSI score ($p = 0.035$). In Bonferroni-adjusted post hoc comparisons, the ABSI score was significantly higher in the major amputation group than in the no-amputation group.

In contrast, no significant pairwise differences were observed for length of hospital stay or TBSA. Cause of burn ($p = 0.002$) and location of injury ($p = 0.018$) also differed significantly among the amputation groups. No significant differences were observed in age, ICU length of stay, complication rates, or mortality (all $p > 0.05$) (Table 4).

Table 4. Comparison of the demographic and clinical characteristics of the patients according to amputation status.

	No (n = 36)	Minor amputation (n = 10)	Major amputation (n = 5)	p
Age (years) *	33 (17-39.3)	41 (29-53.3)	49 (38-49)	0.071
Length of hospital stay (days) *	26.5 (8.8-37.8)	39.5 (23.5-59.5)	44 (42-63)	0.021
ICU length of stay (days) *	1 (0-5)	3 (2-8.3)	7 (6-12)	0.060
Sex **				
Female	5 (13.9)	0 (0.0)	0 (0.0)	0.749
Male	31 (86.1)	10 (100.0)	5 (100.0)	
Occupational injury (yes) **	9 (25.0)	3 (30.0)	3 (60.0)	0.243
Cause of burn **				
Outdoor electrical accident	5 (13.9)	6 (60.0)	2 (40.0)	0.002
Indoor electrical accident	21 (58.3)	1 (10.0)	0 (0.0)	
Occupational accident	9 (25.0)	3 (30.0)	3 (60.0)	
Lightning	1 (2.8)	0 (0.0)	0 (0.0)	
Location of injury **				
Outdoor	14 (38.9)	7 (70.0)	5 (100.0)	0.018
Indoor	22 (61.1)	3 (30.0)	0 (0.0)	
TBSA (%) *	16.5 (10-25.8)	15 (12.8-18.8)	35 (30-38)	0.042
ABSI score *	4 (4-6) ^a	5 (4-6) ^{a, b}	7 (6-7) ^b	0.035
Surgery (yes) **	28 (77.8)	10 (100.0)	5 (100.0)	0.194
ABSI mortality risk **				
Very low	4 (11.1)	0 (0.0)	0 (0.0)	0.051
Low	22 (61.1)	7 (70.0)	0 (0.0)	
Moderate	5 (13.9)	2 (20.0)	4 (80.0)	
High	4 (11.1)	1 (10.0)	1 (20.0)	
Very high	1 (2.8)	0 (0.0)	0 (0.0)	
Complications (yes) **	21 (58.3)	7 (70.0)	5 (100.0)	0.249
Mortality (ex) **	2 (5.6)	0 (0.0)	0 (0.0)	1.000
Burn severity **				
Moderate	8 (22.2)	0 (0.0)	0 (0.0)	0.195
Major	28 (77.8)	10 (100.0)	5 (100.0)	

Superscript letters (^a, ^b) indicate the results of Bonferroni-adjusted post hoc pairwise comparisons. Groups without a common superscript letter differ significantly ($p < 0.05$), whereas groups sharing at least one letter do not differ significantly.

* Median (IQR), ** n (%). TBSA, total body surface area; ABSI, Abbreviated Burn Severity Index; ICU, intensive care unit.

In the subgroup analysis according to burn etiology ($n = 50$), patients with occupational electrical injuries had the longest hospital stay [41 (26–59.5) days; $p = 0.009$], whereas those injured in outdoor electrical accidents had the highest median age [40 (38–56) years; $p = 0.009$] and ABSI score [6 (4–7); $p = 0.023$]. Outdoor exposure was observed in 100% of the outdoor electrical accident

group and 80.0% of the occupational injury group, but in none of the indoor electrical accident group ($p < 0.001$). Furthermore, the proportion of major burns was 100%, 93.3%, and 68.2% in the outdoor electrical accident, occupational injury, and indoor electrical accident groups, respectively ($p = 0.026$) (Table 5).

Table 5. Comparison of demographic and clinical characteristics according to the cause of burn.

	Outdoor electrical accident ($n = 13$)	Indoor electrical accident ($n = 22$)	Occupational injury ($n = 15$)	p
Age (years) *	40 (38–56) ^a	27.5 (14–41) ^b	36 (23.5–41.5) ^{a,b}	0.009
Length of hospital stay (days) *	34 (20–49) ^{a,b}	22.5 (5–32) ^a	41 (26–59.5) ^b	0.009
ICU length of stay (days) *	6 (0–8)	0 (0–5)	4 (1.5–10)	0.075
Sex **				
Female	0 (0.0)	4 (18.2)	0 (0.0)	0.112
Male	13 (100.0)	18 (81.8)	15 (100.0)	
TBSA (%) *	15 (12–30)	15 (8–25)	20 (15–41)	0.182
ABSI score *	6 (4–7) ^b	4 (4–5) ^a	5 (4–7.5) ^b	0.023
Mortality (ex) **	0 (0.0)	0 (0.0)	1 (6.7)	0.560
Location of injury **				
Outdoor	13 (100.0)	0 (0.0)	12 (80.0)	< 0.001
Indoor	0 (0.0)	22 (100.0)	3 (20.0)	
Burn severity **				
Moderate	0 (0.0)	7 (31.8)	1 (6.7)	0.026
Major	13 (100.0)	15 (68.2)	14 (93.3)	
ABSI mortality risk **				
Very low	0 (0.0)	3 (13.6)	1 (6.7)	0.222
Low	7 (53.8)	15 (68.2)	7 (46.7)	
Moderate	4 (30.8)	4 (18.2)	3 (20.0)	
High	2 (15.4)	0 (0.0)	3 (20.0)	
Very high	0 (0.0)	0 (0.0)	1 (6.7)	

Superscript letters (^a, ^b) indicate the results of Bonferroni-adjusted post hoc pairwise comparisons. Groups without a common superscript letter differ significantly ($p < 0.05$), whereas groups sharing at least one letter do not differ significantly. * Median (IQR), ** n (%). TBSA, total body surface area; ABSI, Abbreviated Burn Severity Index; ICU, intensive care unit. The single patient with a lightning injury was not included in the subgroup analysis because this category contained only one patient and was not suitable for meaningful statistical comparison; therefore, the analysis included 50 patients.

4. Discussion

Electrical burns are among the most devastating traumatic injuries because of the extensive deep tissue damage, multisystem involvement, and high risk of complications that contribute substantially to morbidity and mortality [1–3,8]. Therefore, a comprehensive evaluation of the epidemiological and demographic characteristics of this patient population, together with the underlying mechanisms of injury, may improve our understanding of the factors influencing clinical course and treatment outcomes. Although several epidemiological studies on electrical burns have been published, contemporary data from the Black Sea region remain limited. Kurt et al. previously evaluated 94 patients hospitalized for electrical burn injuries in Samsun between 2008 and 2012 [9]. Building on this earlier regional research, our study evaluates a more recent cohort of patients hospitalized at a tertiary burn center, providing updated information on the epidemiological and clinical characteristics, complications, and treatment outcomes of electrical burn injuries.

Furthermore, as our tertiary burn center serves the Black Sea region and accepts referrals from neighboring provinces, our findings provide contemporary regional epidemiological and clinical data, contributing to both regional knowledge and the national literature.

Chen and Wang reported that 89.2% of patients with electrical burn injuries were male, with a median age of 28 years, based on data from the World Health Organization Global Burn Registry [10]. Similarly, Kurt et al. found that 89% of patients in their regional cohort were male [9]. Sun et al. likewise reported that 90.3% of patients were male and that 20% of the study population consisted of pediatric patients [11]. Our findings are consistent with these previous reports, with males accounting for 90.2% of the study population and a median patient age of 36 years (IQR, 20–44). These findings further support the observation that electrical burn injuries predominantly affect men of working age.

In the present study, eight of the 51 patients were children, and a lightning strike caused one case. Electrical burns remain an important cause of morbidity in chil-

dren because their ability to recognize environmental hazards and protect themselves is not yet fully developed. In a recent pediatric study, Hu et al. demonstrated that most electrical burn injuries occurred in younger children and predominantly in the home environment, emphasizing that improved parental supervision and strengthened household electrical safety measures play a crucial role in preventing these injuries [12]. Accordingly, increasing public awareness, promoting home electrical safety, and educating families should be considered essential preventive strategies to reduce the incidence of pediatric electrical burn injuries.

Karadaş et al. reported that 54.5% of electrical injury cases resulted from high-voltage exposure, whereas 45.5% resulted from low-voltage exposure [13]. Similarly, Al et al. found that 41.8% of cases were caused by high-voltage injuries and 58.2% by low-voltage injuries [14]. Consistent with these findings, high-voltage electrical burns were more common than low-voltage burns in our cohort, accounting for 58.8% of all cases. The relatively higher amputation rate observed in our study may be attributable to the inclusion of only hospitalized patients treated at a tertiary burn center, who generally presented with more severe injuries. Reported mortality rates following electrical burns range from 2.35% to 26.7% in the literature [9,10,13]. The in-hospital mortality rate in our study was 3.9%, which is within the reported range.

Our findings demonstrate that high-voltage electrical burns were associated with a more severe clinical course than low-voltage injuries, characterized by greater burn extent and severity, longer hospital and ICU stays, and higher frequencies of deep burns, surgical intervention, amputation, and complications. This pattern is consistent with the greater energy transfer and deep tissue involvement characteristic of high-voltage electrical injuries.

Cutaneous lesions do not always reflect the true extent of tissue injury following electrical burns. Particularly in high-voltage injuries, damage to muscles, blood vessels, and nerves along the path of the electrical current may result in extensive tissue necrosis disproportionate to the apparent skin lesions. Our findings are consistent with previous studies demonstrating that high-voltage electrical burns are associated with larger burn size, more extensive deep tissue injury, and a more severe clinical course [9,11,13–15]. In addition, the higher frequency of occupational accidents and outdoor exposure among patients with high-voltage burns observed in our study further supports that these injuries are predominantly related to occupational exposure.

Although mortality occurred exclusively in the high-voltage group, the difference between the voltage groups was not statistically significant. The small sample size and limited number of deaths may have reduced the statistical power to detect a difference in mortality. Başaran et al. [16] reported a positive correlation between TBSA and both hospital and ICU length of stay in patients with electrical burns. Still, they concluded that TBSA alone was insufficient to predict the development of complications. Similarly, the higher TBSA, elevated ABSI scores, increased complication and amputation rates, and prolonged hospitalization observed in patients with high-voltage injuries in our cohort indicate an association be-

tween high-voltage exposure and greater overall injury severity.

In the present study, greater burn depth was associated with greater TBSA involvement, higher ABSI scores, increased burn severity, and a higher frequency of amputation. In particular, fourth-degree burns were associated with greater TBSA and higher ABSI scores compared with second-degree burns. These findings are consistent with previous studies reporting associations between deep electrical burns and a more severe clinical course and poorer treatment outcomes [6–9,15]. Overall, the observed associations suggest that greater burn depth may reflect greater injury severity; however, the present analysis does not establish burn depth as an independent prognostic determinant.

In the present study, length of hospital stay, TBSA, and ABSI score differed significantly among the amputation groups. However, after Bonferroni adjustment, pairwise differences in length of hospital stay and TBSA were not statistically significant. Previous studies have reported prolonged hospitalization among patients with electrical burns requiring amputation [5,8,17]. In contrast, the ABSI score was significantly higher in patients undergoing major amputation than in those without amputation in our cohort, suggesting greater overall injury severity in patients requiring major amputation. Previous studies have suggested that amputation following electrical burns is related not only to the extent of burns but also to deep muscle necrosis, vascular injury, and the anatomical pathway of the electrical current through the body [4,5]. However, given the small number of patients in the major amputation group, these findings should be interpreted with caution.

Patients with occupational electrical injuries had significantly longer hospital stays, whereas those injured in outdoor electrical accidents exhibited higher ABSI scores and a greater proportion of major burns. These findings suggest that injury mechanism and location are associated with differences in clinical severity. Previous studies have likewise demonstrated that electrical burns sustained outdoors or during occupational activities are predominantly associated with high-voltage exposure and consequently result in a more severe clinical course and prolonged treatment [2,3,9,11]. Our findings are in agreement with these observations.

5. Limitations

This study has several limitations. First, the retrospective, single-center design limits the generalizability of the findings. The small sample size and limited number of deaths and major amputations may have reduced the statistical power of the analyses. The inclusion of hospitalized patients only and the exclusion of patients with incomplete medical records may have introduced selection bias. Moreover, the small number of patients in some subgroup analyses may limit the reliability of these comparisons. Given these limitations, multivariable analysis was not considered appropriate; therefore, the observed associations should not be interpreted as independent predictors of clinical outcomes. Finally, the retrospective assessment of variables such as burn depth,

TBSA, voltage category, and complications relied on existing medical records and may therefore be subject to documentation or misclassification bias. Therefore, our findings should be interpreted with caution and validated in larger, multicenter, prospective studies.

6. Conclusions

This study provides contemporary epidemiological and clinical data on patients hospitalized with electrical burns at a tertiary burn center. High-voltage electrical injuries were associated with greater burn extent, higher ABSI scores, longer hospital and ICU stays, and higher rates of surgical intervention, amputation, and complications. Greater burn depth was also associated with increased injury severity. Given the retrospective, single-center design and small sample size, the findings should be interpreted with caution and confirmed in larger, multicenter studies.

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Conflict of Interest

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Data Availability

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author upon reasonable request.

AI Assistance

During the preparation of this manuscript, ChatGPT (GPT-5.5, OpenAI) was used exclusively for language editing and stylistic refinement. The authors take full responsibility for the content, interpretation, and conclusions of the published article.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Samsun University Clinical Research Ethics Committee (Approval No. GOKAEK 2024/14/14; Date: August 14, 2024). Due to the study's retrospective design, the ethics committee waived the requirement for informed consent.

Author Contributions

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Doğukan Can Öztürk: conceptualization, data curation, investigation, supervision, visualization.

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Alper Ceylan: resources, supervision.

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