DOI: https://doi.org/10.54393/pjhs.v6i1.2628

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (P): 2790-9352, (E): 2790-9344
Volume 6, Issue 01 (January 2025)

Original Article

OPEN ACCESS

Clinical Pattern of Limb Loss in Electrical Burn Injuries

Aamna Sanober[1*], Afaq Saleem Siddique[2], Shahzad Shaikh[3], Samra Irshad[4], Pir Naveed Ahmed Ahsan Qureshi[4], Hira Sangrasi[4] and Rabia Memon[1]

[1]Department of Plastic Surgery, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
[2]Department of Plastic Surgery, Liaquat National Hospital, Karachi, Pakistan
[3]Department of Plastic Surgery, Bilawal Medical College, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
[4]Department of Plastic Surgery, Liaquat University Hospital, Hyderabad, Pakistan

ARTICLE INFO

Keywords:
Electrical Burn Injuries, Amputations, High-Voltage Burns, Total Body Surface Area

How to Cite:
Sanober, A., Siddique, A. S., Shaikh, S., Irshad, S., Ahsan Qureshi, P. N. A., Sangrasi, H., & Memon, R. (2025). Clinical Pattern of Limb Loss in Electrical Burn Injuries: Limb Loss in Electrical Burn Injuries. Pakistan Journal of Health Sciences, 6(1), 87-91. https://doi.org/10.54393/pjhs.v6i1.2628

***Corresponding Author:**
Aamna Sanober
Department of Plastic Surgery, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
aamna.sanober@lumhs.edu.pk

Received Date: 3rd December, 2024
Acceptance Date: 23rd January, 2025
Published Date: 31st January, 2025

ABSTRACT

Electrical burn injuries are severe and often lead to significant morbidity, including amputations, especially in high-voltage cases. These injuries commonly occur in occupational settings and can result in prolonged hospitalization and complications. Studying clinical patterns in electrical burn injuries is crucial to identifying risk factors, improving early interventions, and guiding effective treatment plans. **Objective:** To analyze the clinical pattern of amputation in electric burn patients at Burns Unit, Liaquat University Hospital, Hyderabad. **Methods:** This prospective observational study was conducted at Liaquat University Hospital, Hyderabad, from Nov 2023 to May 2024. A total of 84 patients, of all ages and both genders who presented with electrical burn injuries were included. While those with scald burns, dry flame burns, contact burns, thermal burns, or uncontrolled diabetes mellitus were excluded. Data collection involved recording demographic details and clinical parameters like the type of burn, total body surface area affected, cause and place of burn, duration of hospital stay, mortality rate and surgical intervention. **Results:** Among all, 54.8% (n=46) required amputations, with 35.7% involving a single limb and 19% multiple limbs. Upper limb amputations were more common (60.9%) compared to lower limb amputations (39.1%), with an 11.9% mortality rate. High-voltage burns were significantly associated with severe total body surface area involvement, prolonged hospitalization, fasciotomies, and multiple limb amputations. **Conclusion:** It was concluded that the study reported a high frequency of limb loss (due to amputation) i.e. 54.8% (n=46) among patients with electric burn.

INTRODUCTION

Electrical burn injuries are among the most severe forms of trauma, with significant physical, psychological, and socioeconomic consequences [1]. These injuries result from direct contact with electrical currents, arc flashes, or thermal burns caused by electrical equipment. The clinical outcomes of electrical burns, particularly limb loss, are devastating, often leading to lifelong disability and impaired quality of life. In Pakistan, the prevalence of electrical burn injuries is rising due to industrialization, unsafe working conditions, and inadequate enforcement of safety standards [2]. Electrical burn injuries are categorized based on the voltage of the electrical current: high-voltage (>1000 volts) and low-voltage (<1000 volts) burns [3]. High-voltage injuries are more likely to cause extensive tissue damage, leading to severe complications such as compartment syndrome, tissue necrosis, and amputations [4]. The mechanism of injury involves the conversion of electrical energy into thermal energy, resulting in deep tissue damage that is often disproportionate to the visible surface injury. Furthermore, these burns may disrupt neurovascular structures, contributing to a higher likelihood of limb loss [5]. Studies from other developing countries with similar socio-economic profiles have shown that high-voltage injuries are predominantly occupational, affecting young male workers in construction and electrical industries [6].

DOI: https://doi.org/10.54393/pjhs.v6i1.2628

However, domestic accidents involving children and women also constitute a significant proportion of cases [7]. The decision to perform an amputation in patients with electrical burns is complex and influenced by multiple factors, including the severity of the burn, vascular compromise, infection, and the risk of systemic complications such as sepsis [8]. However, in resource-limited settings like Pakistan, these diagnostic modalities are not readily available, often leading to delayed interventions and a higher rate of amputations. A study in Taxes - US reported amputation rates as high as 25% among patients with electrical burns, underscoring the urgency of timely management [9]. Despite the significant burden of electrical burn injuries in Pakistan, there is a paucity of data on the clinical patterns of limb loss in these patients. Most studies are single-center reports with small sample sizes, limiting the generalizability of their findings. This study aims to analyze the clinical pattern of amputation in electric burn patients at the Burns Unit of Liaquat University Hospital, Hyderabad.

METHODS

This prospective observational study was conducted at the Department of Plastic and Reconstructive Surgery and Burns Unit, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro/Hyderabad, from Nov 2023 to May 2024. Consecutive purposive sampling was used for patient selection. A total of 84 patients of all ages and genders who presented with electrical burn injuries were included. Meanwhile, those with scald burns, dry flame burns, contact burns, thermal burns, or uncontrolled diabetes mellitus were excluded. Following ethical approval from the ERC (NO. LUMHS/REC/-199), all eligible patients were enrolled in the study after obtaining informed written consent. The sample size was calculated via the Open Epi sample size calculator, taking a percentage of limb loss in electrical burns as 31.7% [10]. The margin of error was 10% and CI was 95%. Data collection involved recording demographic details (age, gender, level of education) and clinical parameters like the type of burn, total body surface area (TBSA) affected, cause and place of burn, duration of hospital stay, infection rate and surgical intervention. Primary outcomes were assessed in terms of fasciotomies and types of amputations. Limb amputation was performed based on critical factors such as the depth of tissue damage involving muscles, bones, and tendons, progressive necrosis despite treatment, severe ischemia causing non-viable tissue and compartment syndrome resulting in increased pressure and irreversible damage. The extent of amputation was classified into minor and major amputations. Minor amputations referred to the amputation of digits while major amputations were defined as amputations below-knee/elbow- or above-knee/elbow joints. Patients were followed up for 3 months' post-discharge to assess their recovery and rehabilitation outcomes. Follow-up evaluations were conducted monthly at the Outpatient Department (OPD). Data were recorded for complications such as delayed healing and infection recurrence. Data were analyzed using SPSS version 22.0. Continuous variables were presented as mean ± standard deviation, while categorical variables such as gender, injury types, and clinical outcomes were expressed as frequencies and percentages. The chi-square test was used to determine the strength of association between different factors with high and low voltage. p-value<0.05 was considered as statistically significant and p<0.01 was considered as highly statistically significant.

RESULTS

The study included 84 patients with electrical burn injuries, predominantly male (73.8%) and aged 18–40 years (61.9%). Most patients were of low socioeconomic status (57.1%) and had high-voltage burns (61.9%). TBSA involvement was moderate (10–20%) in 45.2% of cases. Workplace injuries (54.8%) were the leading cause of burns. Hospitalization ranged from <10 days (42.9%) to >20 days (9.5%) (Table 1).

Table 1: Demographic and Clinical Characteristics of Patients (n=84)

Variables	Frequency (%)
Gender	
Male	62 (73.8%)
Female	22 (26.2%)
Age Groups (Years)	
<18	12 (14.3%)
18-40	52 (61.9%)
>40	20 (23.8%)
Education Level	
Illiterate	36 (42.9%)
Primary	28 (33.3%)
Secondary and Above	20 (23.8%)
Socioeconomic Status	
Low	48 (57.1%)
Middle	30 (35.7%)
High	6 (7.1%)
Type of Electrical Burn	
Low Voltage (<1000 kV)	32 (38.1%)
High Voltage (>1000 kV)	52 (61.9%)
TBSA Affected	
<10% (Minor)	28 (33.3%)
10–20% (Moderate)	38 (45.2%)
>20% (Severe)	18 (21.4%)
Place of Injury	
Workplace	46 (54.8%)
Home	38 (45.2%)

DOI: https://doi.org/10.54393/pjhs.v6i1.2628

Duration of Hospital Stay	
<10 Days	36 (42.9%)
10–20 Days	40 (47.6%)
>20 Days	8 (9.5%)

Among 84 patients with electrical burn injuries, 54.8% (n=46) required amputations, with 35.7% (n=30) involving a single limb and 19% (n=16) multiple limbs. Upper limb amputations were more common (60.9%, n=28) compared to lower limb amputations (39.1%, n=18). Infection was noted in 35.7% of patients, with an 11.9% mortality rate (Table 2).

Table 2: Surgical Interventions and Outcomes (n=84)

Variables	Frequency (%)
Fasciotomies Performed	
Yes	46 (54.8%)
No	38 (45.2%)
Amputations	
None	38 (45.2%)
Single Limb	30 (35.7%)
Multiple Limbs	16 (19.0%)
Type of Amputation	
Upper Limb	28 (60.9%)
Lower Limb	18 (39.1%)
Infection Rate during Hospitalization	
Yes	30 (35.7%)
No	54 (64.3%)
Mortality	
Yes	10 (11.9%)
No	74 (88.1%)

High-voltage burns were significantly associated with severe TBSA involvement (>20%, 26.9%, p=0.002), prolonged hospitalization (>20 days, 15.4%, p=0.008), fasciotomies (69.2%, p=0.001), and multiple limb amputations (23.1%, p=0.026). No significant association was found between burn type and gender, type and extent of amputation, or mortality (Table 3).

Table 3: Association of Type of Electrical Burn with Different Factors

Variables	Low Voltage	High Voltage	p-value
Gender			
Male	22 (68.8%)	40 (76.9%)	0.401
Female	10 (31.3%)	12 (23.1%)	
TBSA Affected			
<10% (Minor)	18 (56.3%)	10 (19.2%)	0.002*
10–20% (Moderate)	10 (31.3%)	28 (53.8%)	
>20% (Severe)	4 (12.5%)	8 (15.4%)	
Duration of Hospital Stay			
<10 Days	20 (62.5%)	16 (30.8%)	0.008*
10–20 Days	12 (37.5%)	28 (53.8%)	
>20 Days	0 (0%)	8 (15.4%)	
Fasciotomies Performed			
Yes	10 (31.3%)	36 (69.2%)	0.001**
No	22 (68.8%)	16 (30.8%)	
Amputations			
None	18 (56.3%)	20 (38.5%)	0.026*
Single Limb	10 (31.3%)	20 (38.5%)	
Multiple Limbs	4 (12.5%)	12 (23.1%)	
Type of Amputation			
Upper Limb	8 (66.7%)	20 (60.6%)	0.721
Lower Limb	4 (33.3%)	12 (39.4%)	
Extent of Amputation			
Minor	20 (83.3%)	12 (54.5%)	0.13
Major	4 (16.7%)	10 (45.5%)	
Mortality			
Yes	2 (6.3%)	8 (15.4%)	0.287
No	30 (93.8%)	44 (84.6%)	

*p<0.05 significant, **p<0.01 highly significant

DISCUSSION

Electrical burns are a major cause of severe injuries requiring surgical intervention, often leading to amputations and long-term morbidity. The current study observed that males (73.8%) aged 18–40 years (61.9%) were predominantly affected, consistent with a study conducted in South China by Ding H *et al.*, which reported 76% male dominance in similar age groups [11]. This trend reflects the higher involvement of males in outdoor, high-risk occupations. International studies, such as one from India by Khor D *et al.*, also found comparable gender ratios [12]. Most patients in this study belonged to low socioeconomic backgrounds (57.1%), aligning with findings by Schaap Re *et al.*, emphasizing the link between poverty and limited workplace safety measures in low-income settings [13]. High-voltage burns accounted for 61.9% of cases, significantly associated with severe TBSA involvement (>20%, 26.9%, p=0.002) and multiple limb amputations (23.1%, p=0.026). These findings are corroborated by a study by Kim E *et al.*, which reported higher TBSA involvement and amputations in high-voltage injuries [9]. Workplace injuries (54.8%) were predominant, similar to findings from Iran, where industrial burns were a leading cause [14]. The average hospital stay was 10–20 days (47.6%), with high-voltage burns significantly prolonging hospitalization (>20 days, 15.4%, p=0.008). These findings align with Tolouie M and Farzan R, which highlighted longer hospitalization in patients with extensive injuries [15]. The findings highlight that high-voltage burns are strongly associated with severe total body surface area (TBSA) involvement, leading to more extensive tissue damage. This results in prolonged hospitalization due to the need for intensive care, multiple surgeries, and extended rehabilitation, emphasizing the need for timely intervention and specialized care for these patients.

DOI: https://doi.org/10.54393/pjhs.v6i1.2628

Mortality in this study was 11.9%, lower than rates reported in an Ethiopian study by Alemayehu S *et al.*, which found 18% mortality, possibly due to differences in healthcare facilities and early intervention [16]. Amputations were required in 54.8% of cases, with single-limb amputations (35.7%) being more frequent than multiple-limb amputations (19%). Upper limb amputations (60.9%) were more common than lower limb (39.1%), which is consistent with studies by Pedrazzi et al., in Switzerland and Kamran M *et al.*, in Pakistan, reporting 58% and 64% upper limb amputations, respectively [17, 18]. High-voltage burns necessitated more fasciotomies (69.2%, p=0.001) and multiple limb amputations (23.1%, p=0.026), in agreement with international data [19]. High-voltage burns are more likely to require fasciotomies due to the severity of tissue damage and compromised blood flow. This finding highlights the need for careful monitoring and prompt surgical management to prevent complications such as compartment syndrome, which could otherwise result in further tissue loss or amputation [20]. While regional studies report similar patterns in demographics and clinical outcomes, developed countries demonstrate lower amputation and mortality rates due to advancements in electrical safety regulations, early rehabilitation, and multidisciplinary approaches[21].

CONCLUSIONS

It was concluded that the study reported a high frequency of limb loss (due to amputation) among patients with electric burns. High-voltage burns were the predominant cause of severe injuries leading to a significantly higher rate of fasciotomies and multiple limb amputations. Upper limb amputations were more common than lower limb amputations. Severe TBSA involvement, longer hospital stays, and infections were significant contributors to the need for surgical intervention. These findings emphasize the importance of early intervention, proper management strategies, and preventive measures to mitigate the devastating outcomes of electrical burn injuries.

Authors Contribution

Conceptualization: AS
Methodology: AS, ASS, SS, SI, PNAAQ, HS, RM
Formal analysis: PNAAQ
Writing review and editing: ASS, SS

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Vaghardoost R, Saraee A, Ghavami Y, Sobouti B. Evaluation of Electrical Burn Injuries in Iran: A 7-Year Retrospective Study. Journal of Burn Care and Research.2022 Jan; 43(1):104-8.doi:10.1093/jbcr/Irab 070.

[2] Dash S, Arumugam Pk, Muthukumar V, Kumath M, Sharma S. Study of Clinical Pattern of Limb Loss in Electrical Burn Injuries. Injury. 2021 Jul; 52(7): 1925-33. doi: 10.1016/j.injury.2021.04.028.

[3] Elfiah U and Akbar WR. Major Burns After Lightning Strikes at Field: Case Report.2022 Oct. doi: 10.191 84/ams.v8i3.31074.

[4] Buckley CT, Velamuri SR, Sultan-Ali I, Arif F, Hickerson WI, Hill Dm. Early Initiation of High-Volume Hemofiltration May Reduce Complications of High-Voltage Electrical Injuries: A Case Report. Burns Open. 2020 Jul; 4(3): 132-6. doi: 10.1016/j. burnso. 2020 .05 .0 02.

[5] Verburg L, Gabriel V, McCaffrey G. The impact of Burn Injuries On Indigenous Populations: A Literature Review. Burns.2024 Mar; 50(6): 1355-1371. doi: 10.1016 /j.burns.2024.02.023.

[6] Habouchi S, Bouamra A, Bezzaoucha A, Joucdar S. Estimation of Survival Rate in Electrical Injuries, Experience in Algerian Burn Centers. Burns Open. 2020 Oct; 4(4): 141-5. doi:10.1016/j.burnso.2020.07. 01.

[7] Alamr F, Alzahrani HM, Alghamdi AM, Alzhrani AS, Alzahrani FA, Alkhediwi LM *et al.* Prevalence and risk factors of home accidents among children under five years of age in Al-Baha, Saudi Arabia. Cureus.2023 Oct; 15(10). doi: 10.7759/cureus.46846.

[8] Bartley CN, Atwell K, Purcell L, Cairns B, Charles A. Amputation Following Burn Injury. Journal of Burn Care and Research.2019 Jun; 40(4): 430-6. doi: 10.1093/jbcr/irz034.

[9] Kim E, Wan B, Solis-Beach KJ, Kowalske K. Outcomes of Patients with Amputation Following Electrical Burn Injuries. European Burn Journal.2023 Aug; 4(3): 318-29. doi: 10.3390/ebj4030029.

[10] Rehan M, Ain QT, Iqbal T, Tariq MH, Khan MS, Waheed U *et al.* Electrical Burn Injuries: Disabling Lives Even in 2022. European Journal of Plastic Surgery. 2023 Dec; 46(6): 1299-304. doi: 10.1007/s00238-023-02088-8.

[11] Ding H, Huang M, Li D, Lin Y, Qian W. Epidemiology of Electrical Burns: A 10-Year Retrospective Analysis of 376 Cases at A Burn Centre in South China. Journal of International Medical Research.2020 Oct; 48(3):0300 060519891325. doi: 10.1177/0300060519891325.

[12] Khor D, AlQasas T, Galet C, Barrash J, Granchi T, Bertellotti R *et al.* Electrical Injuries and Outcomes: A Retrospective Review. Burns.2023 Nov; 49(7): 1739-

DOI: https://doi.org/10.54393/pjhs.v6i1.2628

44. doi: 10.1016/j.burns.2023.03.015.
[13] Schaap R, Schaafsma FG, Bosma AR, Huysmans MA, Boot CR, Anema JR. Improving The Health of Workers with A Low Socioeconomic Position: Intervention Mapping as A Useful Method for Adaptation of the Participatory Approach. BioMed Central Public Health. 2020 Dec; 20: 1-3. doi: 10.1186/s12889-020-09028-2.
[14] Kouchek M, Aghakhani K, Dahmardehei M, Memarian A. Demographic Assessment of Burn Injuries in Iranian Patients. Bulletin of Emergency and Trauma.2024; 12(1): 26. doi: 10.30476/BEAT.2024.99775.1456.
[15] Tolouie M and Farzan R. A Six-Year Study On the Epidemiology of Electrical Burns in Northern Iran: Is It Time to Pay Attention? World Journal of Plastic Surgery.2019 Sep;8(3):365.doi:10.29252/wjps.8.3.365.
[16] Alemayehu S, Afera B, Kidanu K, Belete T. Management Outcome of Burn Injury and Associated Factors Among Hospitalized Children at Ayder Referral Hospital, Tigray, Ethiopia. International Journal of Pediatrics.2020; 2020(1): 9136256. doi: 10.1155/2020/9136256.
[17] Pedrazzi N, Klein H, Gentzsch T, Kim BS, Waldner M, Giovanoli P *et al.* Predictors for Limb Amputation and Reconstructive Management in Electrical Injuries. Burns.2023Aug;49(5):1103-12.doi:10.1016/j.burns.2022.08.007.
[18] Kamran M, Rasool A, Ahsan Z, Tahir M, ur Rehman S, Ahmed A *et al.* A Retrospective Study on Causes of Lower Limb Amputation in Peshawar, Khyber Pakhtunkhwa. Pakistan Journal of Medical and Health Sciences. 2024 Aug; 18(3): 24-. doi: 10.53350/ pjmhs 020241837.
[19] Hidayati CA, Saputro ID, Hutagalung MR. Could Fasciotomy Prevent Amputation in Patients with Electrical Burn Injuries? Insights from A Cross-Sectional Study in Indonesia. Narra Journal.2024 Aug; 4(2): e834. doi: 10.52225/narra.v4i2.834.
[20]Putri AC, Tobing JN, Hasibuan L, Faried A, Mose J. The Evaluation of a Golden Period of Fasciotomy for High Voltage Electrical Burn Injury Patients with Compartment Syndrome.Annals of Burns and Fire Disasters. 2023 Mar; 36(1): 57.
[21] Khatoon MA, Karim SM, Khan L, Karimi S, Abro UF. Exploring the Indications, Levels, and Outcomes of Lower Extremity Amputation at a Tertiary Care Hospital in Pakistan. Cureus.2023 Nov; 15(11). doi: 10.7759/cureus.48856.