ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 04 | April - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

TRACING THE SPARKS: A RETROSPECTIVE STUDY ON THE EPIDEMIOLOGY OF ELECTRICAL BURNS

Plastic Surgery

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ABSTRACT

Background And Objective: Electrical burns are a significant cause of morbidity and mortality, particularly among young working-age males engaged in high-risk occupations such as construction, electrical work, and agriculture. These injuries range from minor burns to severe high-voltage injuries requiring multiple surgeries, amputations, and intensive care. Developing countries face an increasing burden of electrical burns due to unsafe practices and electricity theft. This study aims to analyze the epidemiology, causes, severity, complications, and outcomes of electrical burn injuries in a tertiary care burn center. **Material And Method:** A retrospective study was conducted from January 2023 to December 2024 at SMS Medical College and Hospital, Jaipur, including 750 patients admitted with electrical burns. Patients were categorized based on age, gender, rural or urban residence, voltage exposure, and type of burn. Data on total body surface area burned (TBSA), complications, surgical interventions (fasciotomy, amputations), and outcomes (mortality, discharge, and repeat admissions) were recorded and analyzed. **Results:** The majority of patients were male (88.7%), with the 21-30 years age group most affected (28%). High-voltage burns (>1000V) were predominant (74.8%), with contact burns in 58% of cases. The most common complications were compartment syndrome (29.8%), limb gangrene (20.6%), sepsis (19.4%), and renal failure (14.2%). Amputation was required in 13.4% of cases, and mortality was 22.8%. Electrical injuries peaked in summer and monsoon (48.6%), with monsoon alone contributing 23.7%. **Conclusion:** Electrical burns remain a major public health concern, leading to high morbidity, mortality, and long-term disabilities. Occupational hazards, unsafe farming practices, and electricity theft are key contributors. Early recognition, aggressive surgical management, and improved preventive strategies, including stricter safety regulations and public awareness, are crucial to reducing the burden of electrical burns.

KEYWORDS

INTRODUCTION

Electricity plays a vital role in everyday life, powering homes, industries, and workplaces.

However, its widespread use also increases the likelihood of electrical injuries, which have been reported since the early days of electrification.[1] The first recorded incident occurred in 1879 in France when a carpenter suffered a low-voltage injury of 250V hile using a generator.[2] Today, electrical injuries continue to be a significant occupational hazard, particularly for electricians, construction workers, and industrial employees.[3]

In many developing nations, electricity theft—where individuals illegally access power lines has also become a leading cause of severe electrical burns. The severity of electrical injuries can range from minor burns to extensive tissue and organ damage, depending on factors such as voltage, current type, duration of exposure, and the path the electricity takes through the body. High-voltage injuries, defined as those exceeding 1000V, are particularly dangerous and can lead to severe tissue destruction, amputations, and fatal complications like cardiac arrest.[4]

One of the biggest challenges in managing these injuries is progressive tissue necrosis due to damage to small blood vessels, which often necessitates multiple surgeries and long-term rehabilitation. Beyond physical harm, survivors frequently experience neurological and psychological issues, including memory problems, difficulty focusing, language impairments, and emotional distress, all of which can significantly impact their quality of life and ability to work. Despite their severity, most electrical injuries can be prevented.[5]

Understanding their epidemiology, risk factors, and socioeconomic influences is essential for designing effective prevention strategies, enhancing workplace safety, and raising public awareness. This is especially critical in developing countries, where better safety regulations and education can help reduce both the frequency and long-term consequences of electrical burns.

MATERIAL AND METHODS

This retrospective study was conducted over two years i.e. from 1st January 2023 to 31st December 2024 at a tertiary care burn centre, SMS Medical College and Hospital, Jaipur, Rajasthan which serves as a major referral hospital for electrical burn injuries.

Aim Of The Study:

This study aimed to analyze the epidemiological patterns of electrical burns, including patient demographics, causes of injury, severity, and outcomes.

Patient Selection:

A total of 750 patients admitted with electrical burns were included in the study. Patients with incomplete records or those discharged against medical advice were excluded. Patients were categorized into the age groups of ten starting from 0 – 70 years.

Data Collection:

Following data were collected using hospital records and burn proformas: Demographic details (age, sex, occupation, rural/urban residence), type and severity of burns (percentage of total body surface area burned), circumstances of injury (occupational, accidental, or intentional), length of stay, complications like renal failure and associated injuries.

Requirement for surgical procedures such as fasciotomy or amputation or reconstructive surgery were also recorded along with mortality rates.

Classification Of Electrical Burns:

Electrical burns were categorized based on the type and voltage of electrical exposure:

Type Of Burn: Contact burns, flash burns, or a combination of both.

Voltage Level: High voltage (>1000V) and Low voltage (<1000V).

Each patient underwent a detailed clinical examination upon arrival. The TBSA involvement was determined using the Lund and Browder chart, and patients with extensive burns or deep tissue damage were evaluated for compartment syndrome. Fluid resuscitation was guided by the Parkland formula, with urine output monitoring set at 1–2 mL/kg/hr for contact burns and 0.5–1 mL/kg/hr for flash burns. Then after further relevant investigations, ICU admission and surgical intervention were carried out depending upon the condition and requirement of the patient after clinical assessment.

RESULTS

A total of 750 patients admitted with electrical burns were included in the study. Patients with incomplete records or those discharged against medical advice were excluded. The majority of the patients were male, accounting for 88.7% (665 cases), while females constituted 11.3% (85 cases). The most affected age group was 21-30 years, comprising

28% of cases,with children under 10 years accounted for 6% of cases, while individuals over 50 years made up 9.3%. A higher proportion of patients came from rural areas (61.3%) compared to urban areas (38.7%). Occupational injuries were the most common cause of electrical burns, accounting for 41.2% of cases. These mainly affected construction workers, electricians, and industrial labourers, with incidents occurring due to direct contact with live wires, faulty installations, and inadequate protective measures. Agricultural-related electrical burns accounted for 27.6% of cases, often resulting from contact with overhead power lines, faulty irrigation systems, or unsafe use of electrical equipment in fields. Electricity theft-related injuries were also significant, comprising 22.3% of cases. These occurred when individuals attempted unauthorized connections to power lines or tampered with transformers, often leading to severe high-voltage burns. Non-occupational accidental burns accounted for 8.9% of cases, mostly due to household wiring issues or exposed electrical sources in public spaces.

Table 1: Age Wise Distribution

Age group (Years)	Number of patients (%)
0-10	45 (60 %)
11-20	140 (18.7%)
21-30	210 (28%)
31-40	180 (24%)
41-50	105 (14%)
51-60	45 (6%)
>60	25 (3.3%)

Electrical burns were categorized into contact burns (58%), flash burns (20%), and a combination of both (22%). High-voltage injuries (>1000V) were predominant, affecting 74.8% of patients, while low-voltage burns (<1000V) accounted for 25.2%.

The mean total body surface area burned was 30.1% ± 22.7%, and the average hospital stay was 14.3 ± 6.5 days. Most common complication was compartment syndrome requiring fasciotomy, after which limb could be salvaged with minor amputation of toes and fingers followed by major limb gangrene requiring amputation, sepsis, renal failure, defects of scalp, abdomen and face requiring flap covers. Limb gangrene occurred which in 20.6%, necessitating major amputation in 13.4% of cases, with below-elbow and below-knee amputations being the most common.

Table 2: Complications

Complications	Number of patients (%)
Compartment syndrome	224 (29.8%)
Limb gangrene	155 (20.6%)
Sepsis	145 (19.4%)
Renal failure	107 (14.2%)
Defects and other minor complications	119 (15.86%)

Other associated injuries included fractures (14.8%), spinal injuries (4.3%), head injuries (10.7%), and chest trauma (5.9%). Vision loss due to electrical burns was observed in 3.2% of cases. The overall mortality rate was 22.8%, with 171 deaths recorded, primarily due to multi-organ failure and sepsis.

Table 3: Outcome

Outcome	Number of patients (%)
Discharged	505 (67.3%)
Mortality	171 (22.8%)
Repeat admission within 1 week for some complication	57 (7.6 %)

Electrical injuries peaked during summer and monsoon (48.6%), with the monsoon alone contributing 23.7%. Spring and autumn accounted for 39%, primarily from industrial and household incidents, while winter had the lowest incidence (12.4%), with 3.9% linked to heating devices.

DISCUSSION

Electrical burns remain a significant cause of morbidity and mortality, particularly among young, working-age males who are at the highest risk. In our study, 88.7% of the patients were male, a finding consistent with previous research that highlights men's greater exposure to electrical hazards due to occupational risks. Similar trends were observed in studies by Buja et al, where over 90% of electrical burn cases involved men.[6,7]The high prevalence of young adults in our study aligns with previous studies by Buja et., with occupational injury rate (41.2%), agricultural-related burns (27.6%) and electricity theft injuries (22.3%) also being prominent, emphasizing that unsafe farming practices and illegal power connections have become major contributors to electrical injuries in developing regions.

The severity of electrical burns in our study was evident in the predominance of high-voltage injuries (74.8%), which often lead to extensive tissue damage requiring surgical intervention. High-voltage burns were more frequently associated with complications such as renal failure (14.2%), sepsis (19.4%), and compartment syndrome necessitating fasciotomy (29.8%), findings that are consistent with earlier studies.[7] Our study recorded an amputation rate of 13.4%, which, while lower than the rates reported by Kym et al. (15.6% for low-voltage and 42% for high-voltage burns), still represents a significant burden.[8]

Upper limb amputations were more common due to direct hand contact with electrical sources, whereas lower limb amputations typically resulted from grounding injuries. These observations underscore the importance of early recognition of progressive tissue necrosis and timely surgical intervention to prevent further complications.The overall mortality rate in our study was 22.8%, which is higher than figures reported in developed nations, where mortality rates typically range from 3% to 15%. This discrepancy may be attributed to delayed medical intervention, disparities in healthcare access, and the high proportion of severe cases referred to our tertiary care center. Previous studies have established that mortality in electrical burns is often linked to complications such as multi-organ failure, acute kidney injury, and sepsis, particularly in patients with extensive burn involvement. Our findings further reinforce the need for prompt wound management, infection control, and early surgical intervention to improve patient survival.

Beyond the immediate physical injuries, electrical burn survivors often experience long-term functional impairment, chronic pain, and psychological distress. Previous studies have demonstrated that patients requiring amputations face significant challenges in resuming work, which leads to long-term economic and social consequences.[5] Our study supports these findings, highlighting the necessity of rehabilitation programs, vocational training, and psychological support to facilitate the reintegration of survivors into society.

Electrical injuries showed a seasonal variation, with the highest incidence during the summer and monsoon months (June–September). This increase was linked to higher outdoor labor, construction activity, and electricity theft-related accidents. The monsoon season alone contributed 23.7% of case contact with wet electrical surfaces and exposed power lines.[10]

This seasonal trend highlights the increased risk of electrical burns during hot and rainy months, emphasizing the need for preventive measures and safety regulations, particularly high-risk occupations.

Given that many electrical burns are preventable, public health initiatives should prioritize education and enforcement of safety regulations. Effective prevention strategies should involve stricter implementation of electrical safety laws, enhanced workplace training, and public awareness campaigns targeting at-risk populations. In particular, addressing electricity theft through legal enforcement and safer alternatives for power distribution could significantly reduce injuries in developing countries. Utilizing mass media, social awareness programs, and mandatory safety training for workers in high-risk professions are essential steps toward minimizing both the incidence and severity of electrical burns.

CONCLUSION

Electrical burns are a major cause of morbidity and mortality, particularly among young working males, with high-voltage injuries leading to severe complications, amputations, and fatalities. Occupational hazards, unsafe electrical practices, and electricity theft significantly contribute to these injuries, especially in developing regions. Early medical intervention, timely surgical management, and proper rehabilitation are essential for improving patient outcomes. Preventive measures, including stricter enforcement of safety regulations, public awareness campaigns, and better workplace safety protocols, are crucial in reducing the incidence of electrical burns. A multi-faceted approach involving education, enforcement, and

infrastructure improvements is necessary to minimize the long-term impact of these devastating injuries.

REFERENCES

1. Arnoldo BD, Hunt JL, Sterling JP, Purdue GF. Electrical injuries. In: Herndon DN, ed. 'Total Burn Care', 4th ed. London: Elsevier Health; 2012: 433- 439
2. Acosta AS, Azarcon-Lim J, Ramirez AT. Survey of electrical burns in Philippine General Hospital. Ann N Y Acad Sci. 1999;888:12–18.
3. Electrical burn injuries. An eight-year review. In: Buja Z, Arifi H, Hoxha E. Annals of Burns and Fire Disasters, 2010
4. Ramakrishnan KM, Ramachandran K, Jayaraman V. Electrical burns treated in an Indian hospital. Burns . 1991;17:481–483.
5. Gandhi, G., Parashar, A., & Sharma, R. K. (2022). Epidemiology of electrical burns and its impact on quality of life-the developing world scenario. World journal of critical care medicine, 11(1), 58.
6. Buja Z, Arifi H, Hoxha E. Electrical burn injuries. An eight-year review. Ann Burns Fire Disasters. 2010;23(1):4–7.
7. Kurt A, Yıldırım K, Kelahmetoğlu O. Electrical burns: highlights from a 5-year retrospective analysis. Ulus Travma Acil Cerrahi Derg. 2016;22(3):278–282
8. D Kym, DK Seo, GY Hur2, JW Lee. doi: 10.1177/1457496914534209. Epidemiology Of Electrical Injury: Differences Between Low- And High-Voltage Electrical Injuries During A 7-Year Study Period In South Korea
9. Bingham H. Electrical burns. Clin Plast Surg. 1986;13:75–85.
10. Arumugam PK, Thakur P, Sarabahi S. Changing trends in electrical burns from a tertiary care centre-epidemiology and outcome analysis. Annals of burns and fire disasters. 2021 Dec 31;34(4):351.