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## Electric burn profile at major burn centre in India

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### Abstract

**Background:** Burns are major public health problem in India. Electric burns are most devastating which causes development of multiple injuries with high morbidity and mortality. Electric burn management requires multidisciplinary, multispecialty approach.

**Aim:** To highlight the epidemiological variables, clinical characteristics, wound management and outcome of electric burns.

**Materials and Methods:** A prospective study was conducted at Department of Burns, Plastic and Reconstructive surgery, Sawai Man Singh hospital, Jaipur, Rajasthan, India from January 2019 to December 2019 that included 347 patients. Patients were admitted and resuscitated at burn unit. Patients were interviewed for clinical history and examined. Wound management, coverage procedure, complications and duration of hospital stay were recorded.

**Results:** The study comprised of 347 patients. Mostly electric burn victim were males (77.5%) and commonly affected age group were 20-40 yrs (45.5%). Most were injured in work related circumstances. High voltage electric burns were seen in 53.6%. Primary cause was accidental direct contact with electric wire (58.2%). Among them 23.6 % had severe burn. Most of patients underwent some sort of surgery. Out of 235 operated patients, 50.6 % underwent skin auto grafting. Amputation was carried in 19% cases and concentrated on upper limbs. Most common complication was septicaemia (21.3%). 8 % patient expired.

**Conclusion:** Electric burn injuries cause extensive damage, complications and prolonged morbidity. High degree of suspicion, more aggressive management require to unfold and minimize the deep seated insult. Public awareness, education and proper training are best way to minimize the significant burden caused by electric burns.

**Keywords:** Electric burn, clinical spectrum, wound management, outcome, prevention strategy

### 1. Introduction

Burn injuries are most devastating among all injuries. Due to extensive use of electricity, hazards of electric injuries are rising<sup>[1-3]</sup>. Electric injury not only involves the skin but also involve deeper tissues that causes multiple acute and chronic manifestations.

Electric burns are severe, had higher disability and mortality rate, more complicated management, long term hospitalization and more costly expenditures and therefore perceived as one of the most devastating injuries<sup>[4-6]</sup>. The effects of electricity on the body are determined by several factors: type (alternating or direct), amount, pathway, duration, area and resistance of body and voltage<sup>[1, 6]</sup>.

Electric burns are classified into low-voltage (< 1000 v) and high voltage burns (>1000v). Adults are more prone to electric injuries at workplace, whereas children at home or while playing<sup>[2]</sup>.

The clinical spectrum of electric burn can vary from mild complaints to life threatening conditions that require serious medical help<sup>[7]</sup>. Management of electric burns is nonspecific, mainly symptomatic and preventing complications.

Electric injuries in growing countries are more due to lack of appropriate training and education regarding safety and proper handling of electricity and scarcity of protective equipments.

### 2. Materials and methods

This is a descriptive study conducted prospectively in SMS hospital Jaipur India from January 2019 to December 2019. The study consists of 347 admitted patients who sustained electrical burns having cutaneous injuries regardless of age and time of burn.

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The excluded patients were those admitted for reconstruction, secondary procedure, contact burn and readmissions.

Informed consent obtained. ECG monitoring, initial labs/diagnostics were taken. Patients with moderate to major burns were resuscitated with parkland formula to maintain an adequate urine output. Tetanus immunization given. Prophylactic antibiotics were used. Escharotomy/fasciotomy was done when there were signs of compartment syndrome. Wound care done with silver sulfadiazin dressing. Wound status assessed regularly during dressing changes. Debridement of necrotic tissue, limb/digits amputation and skin grafting done when needed. Physiotherapy started from the day of injury. Splinting and positioning were maintained to prevent contracture.

The following data were collected: clinical characteristics (demographic data, electricity voltage, burn area and injury site) wound management (type and duration of surgery) and outcomes (amputation, death, length of stay).

### 3. Results

This study reveals that most of the electric burn patients were adults (77.5%). Majority of patients were in the third and fourth decade of their life.

**Table 1:** Demographic profile of the study

Sex	Number of Patients	Percentage
Male	269	77.5%
Female	78	22.5%
Age	Number of Patients	Percentage
< 20 YR	39	11.2%
20-40 YR	158	45.5%
40-60 YR	141	40.6%
>60 YR	09	2.59%
Place of Burn	Number of Patients	Percentage
Working Place	188	54.1%
Home	133	38.3%
Street	12	4.8%
Tree	9	2.6%

**Table 2:** Etiology of electric injury

Type of electric injury	Number of patients	Percentage
Low Voltage (<1000 V)	186	53.6%
High Voltage (>1000 V)	161	46.4%
Mode of Injury	Number of Patients	Percentage
Direct Contact	202	58.2%
Secondary Contact	145	41.8%
Flame(Ignition of Clothes)	106	30.5%
Tbsa (Total Body Surface Area)	Number of patients	Percentage
Minor (<10%)	97	27.9%
Moderate (11-20%)	168	48.4%
Severe (>20%)	82	23.6%

Most of burns occurred at working place (54.1%) followed by at home (38.3%). Direct contact with electric powerline (58.2%) was the most common mode of electric injury. In 41.8% of cases, accidental contact with electrical power lines by metal rods, ladders, and accidental electrification of different metallic equipments caused by electric injury. Table shows that high voltage electrical injury (53.6%) was a common cause of admission. Most of the individuals with severe tbsa (23.6%) came from high voltage. Study shows 72.5% of patients stayed in hospital stayed in hospital longer than 14 days.

**Table 3:** Primary hospitalization period

Length of hospital stay	Number of patients	Percentage
< 7 DAYS	54	15.5%
7 – 14 DAYS	41	11.8%
14 – 21 DAYS	57	16.4%
> 21 DAYS	195	56.1%

**Table 4:** Operative Procedures for the Patients

Operations	Number of Patients	Percentage
0	120	34.5%
1	116	33.4%
2 And more surgery	111	31.9%
Type of operation	Number of patients	Percentage
Fasciotomy	88	25.3%
Debridements	131	37.7%
Skin grafting	119	34.2%
Flap coverage	32	9.2%
Amputation	66	19.0%

Operations were performed on 65.5% of patients. Total of 88 fasciotomy and 131 debridments were carried out. 50.6% of total operated cases underwent skin grafting. In 13.6% of operated cases different flaps were used for soft tissue coverage of defects.

34.5% cases were treated conservatively.

Amputations were carried in 19% cases. Mostly amputation of upper limbs took place

**Table 5:** Complications of electric burns

Complications	Number of Patients	Percentage
No Complications	156	44.9%
Acute Renal Failure	54	15.2%
Septicaemia	70	20.1%
Amputation	66	19.0%
Wound Infections	47	13.5%
Death	28	8%

The most common complication was septicaemia in 20.1%; others were acute renal failure and wound infection.

While 44.9% pt had no complications.

Mortality from electric injury was 8%.

### 4. Discussion

From January 2019 to December 2019, total 1143 burn patients were admitted. Among them 38.4% patients (including readmissions) were with electrical injuries.

The prevalence of electrical injury is higher in developing countries due to low socioeconomic status, poorly insulated wires, wrongly placed electrical switches, illegal electrical connections, and repair work by non professionals<sup>[8]</sup>. Adult

males (77.5%) at work place (54.1%) were more affected. This is due to lack of proper training and handling of electricity plus the increased exposure to potential hazards due to rapid industrialization. A 10 year study in china also revealed similar findings<sup>[9]</sup>. Salehi *et al.* 2014 study also showed similar finding<sup>[10]</sup>. Other study in India supports our study<sup>[11]</sup>.

Electric burns have marked functional and cosmetic sequelae, adversely affect family economy. In our study, 21–40 yr is the most common affected age group (earning age group having the highest dependency ratio).

The utility poles and high-voltage electrical lines at the farm/agricultural land, wiring placed at low heights, substandard electric wiring in houses and experiments with household electricity by inexperienced individuals lead to major cases of electric burns in our study too.

The frequency of high-voltage and low-voltage burns varies in different setups. High-voltage injuries in Iran (56%) and US (37.51) while that of low voltage is 44% and 39.57% respectively<sup>[12-13]</sup>. In our study, injury due to high voltage found in 186 patients (53.6%) and that due to low voltage was in 161 patients (46.4%).

In our study, burned area varies from 5% to 70%. Majority of patients had a burned area of <20%.

Electric injuries may involve almost every part of the body. Upper limbs were most common site followed by head, face and neck.

In our study 65.5% of patients underwent at least one operation. Surgical treatment is complex. Skin grafts are used in injuries having only skin loss. Skin flaps are used in involved tendons, bones, or joints. In our study, most operated patients underwent skin auto grafting.

High voltage burn had higher tbsa and deeper depth. High voltage burn (53.6%) was common cause of admission which was directly related to severity of injury and duration of hospital stay. It needs different types of surgeries and cause lengthy stay.

This has similarity with other studies, where high voltage was directly related to severity, complications, and amputation.

Amputation rate was 19% in our study and correlate with 10% to 68% in previous studies<sup>[14]</sup>.

In this study mortality rate was 8 %. Mortality are decreasing in due to marked improvement in monitoring, better wound care, and early excision and grafting. In other countries, mortality rate from electrical injury are as follows: Czech Republic (17.07%), turkey (9.1%), Taiwan (6%), United States (3-15%)<sup>[15-18]</sup>.

Invasive infection, leading to sepsis, most common cause of death can be avoided by timely surgical intervention and limits death percentage in burn unit.

The variation of morbidity and mortality depends on severity, characteristics of injury, and level of expertise care that each patient receives. Death of the victim on the scene of incident, delay in carrying to hospital and delay in treatment, and death in hospital in spite of treatment may underestimate mortality.

The psychosocial impact of burn injuries leaves a stigma in patient's life forever and rehabilitation of such patients is another problem.

The enforcement of available safety regulations should be reiterated, and employers should do stricter adherence to regulations. Exposed workers should be fully trained/qualified and properly dressed. The education will lessen the

load of electrical burns, which affects the person, family and workplace.

## 5. Conclusions

Our study reveals that main sufferers of electrical injury were adult males with occupational exposures, and autologous skin grafts were the common strategy of wound management. Prevention and effective strategies of treatment are required to lower down the incidence, improves outcome, and reduce burden on patients, families and society.

Preventive measures like proper education, training, enforcement of law, proper installation of electric system as well as public awareness should be taken.

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