Changing trends in electrical burn injury due to technology

ABSTRACT

Background: Electrical burn injuries result from accidental contact with exposed parts of electrical appliances, wiring, or lightning strikes. The purpose of this study was to analyze the mode of electric burn injuries occurring in the current technological world.

Materials and Methods: A retrospective analysis of 3-year experience of electric burn injury case admitted in the burn unit of our institute was conducted from April 2016 to March 2019. Of the total 3983 patients, 914 patients were of electric burn injury. All age groups of patients were included, with exclusion of thermal, flame, and scald burn patients. We evaluated the variables according to age, sex, total burn surface area, injury type, and mode of injury.

Results: Out of 914 cases, we had admitted 329 cases from February 2016 to August 2017 (Group 1) and 585 cases admitted from September 2017 to March 2019 (Group 2). Seven hundred sixty-nine cases were male and 145 were female. Group 1 had 187 cases in the age group of 40–59 years. While in Group 2, 226 cases were in the age group of 20–39 years. About 40.7% of the cases had electric burn due to working over electric pole in Group 1, while in Group 2, 19.65% cases had electric burn due to malfunctioning of appliances and 2.7% cases had smartphone electric burn injury. About 3.9% of the cases had electric burn due to working or taking selfies near electric train.

Conclusion: In this technology era, the use of electric current in various appliances leads to increase the risk of electric burn injury, and these injuries can be prevented by education and safety measures to reduce the incidence of electrical injuries.

Keywords: Changing trends, electric burn, smartphone injury

INTRODUCTION

Electricity is an integral part of the recent era of technology. Without electricity, existence of human life seems difficult. It has capacity to make the life easy, but sometimes, it destroyed the life up to the death. The most fatalities caused due to electricity are accidental and result from passage of an electric current (both low and high voltage) through the body. Accidental electrocution among these would have occurred because of carelessness, ignorance, haste, malfunction of appliances or equipment such as ineffective insulation, lack of protective earthing, faulty grounding and short circuits.[1,2]

The effects of electrical current depend on the type of current, voltage, tissue resistance, the pathway, and the duration.[3,4] Injuries caused by exposure to 1000 V or greater are considered high-tension electrical burns. High-tension electrical current may cause “flash” burns, “True” electrical burns, or secondary thermal burns.[5,6] High-tension electrical burns result in cutaneous injuries and severe damage to the underlying muscles, nerves, blood vessels, and bones.[7,8] Every organ system can be injured by the passage of current. Respiratory arrest, cardiac arrest, ventricular fibrillation, renal failure, and gangrene of the extremities are some of the early life-threatening complications. In case of lightning, the most common cause of death is respiratory arrest[9,10]. Hence, if only artificial respiration is started immediately, a patient can be revived. Since this should be done at the site of accident, which is more often remote, the mortality rate

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remains high. Domestic electric supply is 220–250 V which causes low-tension electrical burn and causes the highest morbidity.

Therefore, in this study, we have analyzed the changes occurring in the mode of electric burn injury due to the increased usage of electric in this technological world.

**MATERIALS AND METHODS**

A retrospective analysis of 3-year experience of electrical burn patient admitted in the burn unit of SMS hospital was conducted Jaipur from April 2016 to March 2019 According to Table 1. A total of 3983 patients admitted in the burn unit; of them, 914 patients were of electric burn injury. All age group patients with electric burn were included in our study, with exclusion of thermal, flame, and scald burn patients. Of the total 914 cases, males were 769 (84.13%) and females were 145 (15.86%) [Table 2]. Upon arrival, all patients with electrical injuries were thoroughly examined, and complete history was taken for identifying mode of injury, and we have evaluated the variables according to the age, sex, total burn surface area, injury type, and mode. Primary treatment with dressing of burn wound applied to all patients.

**Statistical analysis**

On statistical analysis, we have divided electrical burn injuries cases into two groups: Group 1 is from April 2016 to August 2017 and Group 2 is from September 2017 to March 2019.

We have compared these both groups and calculated with Chi-square test, $P < 0.001$.

**RESULTS**

Of 914 cases of electric burn, we had admitted 329 cases of electric burn injuries from February 2016 to August 2017 (Group 1) and 585 cases admitted from September 2017 to March 2019 (Group 2). Seven hundred sixty-nine (84.13%) cases were male and 145 (15.86%) cases were female. Thus, the male-to-female ratio was 5.3:1. According to Table 1, we observed that in Group 2, electric injury cases were increased as compared with Group 1. In Group 1, the most common age group of 40–59 years had 187 (56.83%) cases, while in Group 2, 226 (38.6%) cases were in the age group of 20–39 years [Table 2], and According to Table 3 40.7% of the cases had electric burn due to working over electric pole in Group 1, whereas Group 2 had 32.64%. malfunctioning of appliances causes electric burn in 19.65% cases. 2.7% cases had smartphone electric burn injury, while 3.9% cases had electric burn due to working or taking selfie near electric train in Group 2. In Group 1, 0.6% of the cases of smartphone burn injury, 1.2% of the cases of electric train burn, and 9.7% of the cases had domestic electric burn injury due to the malfunction of appliance. Therefore, in our study According to Table 4, we had high cases of electric burn injuries in males working on electric pole in Group 1, while in Group 2, we found that electric burn cases were increased in number due to the use of smartphone and malfunction of appliance. On statistically calculated with Chi-square test, $P < 0.001$ suggestive of changes occurring in the mode of electric burn injury is highly significant.

**DISCUSSION**

The widespread commercial utilization of electrical power has been associated with a rapid increase of both fatal and nonfatal injuries. The domestic electrical power used in India is 220 V, alternating at 50 cycles (Hertz) per second, and industrial electrical power is over 440 V

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**Table 1: Demographic distribution of electric injury**

|                | Group 1 (%) | Group 2 (%) | Total  |
|----------------|-------------|-------------|--------|
| Electric burn cases | 329 (36)    | 585 (64)    | 914    |
| Burn cases        | 2290 (57.5) | 1693 (42.5) | 3983   |

**Table 2: Age and sex distribution for electrical burn injuries**

| Age group (years) | Group 1 | Group 2 | Total |
|-------------------|---------|---------|-------|
| 0-19              | 30 (9.1)| 177 (30)|       |
| 20-39             | 81 (24.6)| 226 (38.6)|   |
| 40-59             | 187 (58.83)| 106 (18.1)|   |
| >60               | 31 (9.4)| 76 (12.9)|       |
| Total             | 329     | 585     | 914   |

| Sex              | Group 1 | Group 2 | Total |
|------------------|---------|---------|-------|
| Male             | 769 (84.13)|       |       |
| Female           | 145 (15.86)|       |       |

We have compared this both groups and calculated with Chi-square test, $P <0.001$

**Table 3: Mode of electrical burn injuries**

| Mode of injury               | Group 1 (%) | Group 2 (%) |
|------------------------------|-------------|-------------|
| Accidental contact with wire | 98 (29.7)   | 165 (28.2)  |
| Working on electric pole     | 132 (40.7)  | 191 (32.64) |
| Mechanical fault (transformer) | 61 (18.54) | 75 (12.82)  |
| Malfunction of appliance     | 32 (9.7)    | 115 (19.85) |
| Burn near electric train     | 4 (1.2)     | 23 (3.9)    |
| Smartphone burn              | 2 (0.6)     | 16 (2.7)    |
| Total                        | 329         | 585         |

We have compared this both groups and calculated with Chi-square test, $P <0.001$

**Table 4: Comparison between high-tension injury and low-tension injury in electric burn patients**

| Injury               | Group 1 | Group 2 |
|----------------------|---------|---------|
| High-tension injury  | 233     | 248     |
| Low-tension injury   | 96      | 337     |
| Total                | 329     | 585     |

$P <0.001$
electrical injuries and underlying causes is of prime importance, the ultimate goal being their prevention. Electrical burns and injuries are the result of electrical currents passing through the body. Temporary or permanent damage can occur to the skin, tissues, and major organs.\textsuperscript{[12,13]} The extent of the damage depends on the strength and duration of the electrical current, in which mortality and morbidity are very high when compared to thermal burns. There are various types of electrical injuries such as high voltage, low voltage, and lightning. In general, the type and extent of an electrical injury depends on the intensity (amperage) of the electric current.\textsuperscript{[14,15]} According to Ohm's law, the electric current is proportional to the voltage of the source and inversely proportional to the resistance of the conductor: current = voltage/resistance.\textsuperscript{[15-17]} Thus, the exposure of different parts of the body to the same voltage will generate a different current (and by extension, a different degree of damage) because resistance varies significantly between various tissues. The least resistance is found in nerves, blood, mucous membranes, and muscles; the highest resistance is found in bones, fat, and tendons. The skin has intermediate resistance.\textsuperscript{[17,18]} In our study, we had 3983 cases admitted in the burn unit in 3 years; of them, 914 cases were of electric burn injuries. We had 329 (36\%) cases in Group 1 and 585 cases in Group 2 (64\%), suggestive of increase in the incidence of electrical injuries. Males were 84.13\% and females were 15.86\% including children. While in another study, of the total 62 cases, males were 57 and females were 5 including children. The percentage of male victims 57 (91.93\%) was more compared to female victims 5 (8.06\%).\textsuperscript{[4,5,16,17]} The reason for such a marked male predominance in a variety of studies from different communities probably includes the fact that only males are involved in the electrical works. We had seen higher cases (187) in Group 1 of 40–59 years of age, while in Group 2, 226 cases were in the age group of 20–39 years. This suggested that more adolescent and young age groups were injured with electric current involved in home appliances, domestic work, use of smartphone, and while taking selfie with smartphone near electric train or car. Accidental electrocution among these would have occurred because of carelessness, ignorance, haste, malfunction of appliances or equipment such as ineffective insulation, lack of protective earthing, faulty grounding, and short circuits.\textsuperscript{[10,18]} From our study, it was noted that in previous years, more adult males had electric burn injuries due to their occupation as working on electric pole or in farms and come in contact with high-voltage current wires. However, in recent years, we observed that more and more young adolescent males had electric burn injury due to the use of smartphone and appliances at home.

CONCLUSION

In this technology era, the use of electric current in various appliances leads to increase the risk of electric burn injury, and these injuries can be prevented by education and safety measures to reduce the incidence of electrical injuries.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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