OBSERVATIONAL STUDY OF ELECTRICAL BURN CASES AT A TERTIARY CARE CENTRE IN CENTRAL INDIA

Abhay Saini [a], **Shehtaj Khan** [1,a], **Avinash Yadav** [a], **Gambhir Patel** [a] **and Krishnanand** [a]
[a] Department of General Surgery, L N Medical College and Research Center, Bhopal, Madhya Pradesh

ABSTRACT Background: Electricity has become an integral part of our lives in today's era of technology. Electrical burn injuries comprise a low fraction of the entire burn admissions, but they are potentially a mutilating type. This study aims to know the demographic pattern of electric burn cases in our region and the morbidity and management of electric burn injuries in a tertiary centre of central India. **Methods:** This retrospective study reviewed the medical records of all burn admissions from July 2017 to June 2019. Data were analysed for demographic characteristics, outcomes and patterns of electric burn injury. **Results:** Out of 26 total electric burn cases, the maximum cases (65.38%) were adults above 20. With a male-to-female ratio of 3.5:1 , most of them belonged to rural places. (84.61%) Of all the cases studied, the maximum was of High Voltage (>1000 V) Injury 61.53%, encountered mostly outdoors and at work. Hand (50%) was the commonest part to be affected. 61.53% of all affected individuals had to undergo a surgical intervention, of which 50% underwent debridement, with a mean hospital stay of 27.08+/-12.09 days for high voltage injuries **Conclusions:** Electrical injuries are generally preventable. However, this epidemiological study on the patients of electric burn suggests that most of the human and economic losses caused by the accidents leading to electric burn injuries were young males hailing from rural areas and suffering high voltage burns, which could have been prevented by the implementation of safety measures at workplace. Hence general education regarding safety measures while using electricity should be given in primary schools themselves. In addition, high voltage electrical transmission cables should be placed underground.

KEYWORDS Electric Burn, High voltage injury, Prevention

Introduction

Electricity has become an integral part of our lives in today's era of technology. Without electricity, the existence of human life seems difficult. It has made our lives easy, but it can sometimes destroy life. Electricity travels at approximately 299-330 km per second. It seeks the fastest and shortest path with the least resistance to the earth. "Conductors" can conduct electricity reckoning on moisture content and surface contamination, including all metals, water, humans and even non-metallic materials (trees, ropes etc.).1 When individuals or objects come too near or touch an electrical wire, they will become a part of an electrical circuit leading to an instant flow of electricity through them to the earth. Even less than one ampere of electricity can burn, severely injure or cause death. [1]

The foremost deaths caused by electricity are mostly accidental , which must have occurred due to careless attitude, ignorance, malfunction of appliances or equipment like ineffective insulation, lack of protective earthing, faulty ground cabling and short circuits.[2] The damage caused by electric burn is because of two mechanisms: the local dissipation of heat and the passage of current through the body tissues. [3]

Electrical burn injuries (EBI) comprise a low fraction of the entire burn admissions, but they're potentially a mutilating type.[1] As most of such injuries are preventable, educational programs and safety measures, both by the individual and the society, can bring down the number of such accidents. [4]

DOI: 10.5455/IJMRCR.172-1640319321
First Received: December 24, 2021
Accepted: July 30, 2022
Associate Editor: Ivan Inkov (BG);
[1]Corresponding author: Shehtaj Khan (shehtaj@gmail.com)

Table 1 Age Group With Sex Distribution.

AGE GROUP	No. of cases / Percentage	Male / Female	Male : Female
1-10 years	3 (11.53)	2 / 1	2 : 1
11-20 years	6 (26.92)	3 / 3	1 : 1
21-30 years	9 (30.76)	9 / 0	9 : 0

Male : Female ratio is of 3.5 : 1 in our study

Table 2 Socioeconomic Status.

Socioeconomic Status	No. of Cases	Percentage
Rural	22	84.61
Urban (Slumdwellers)	4	15.38

The intensity of electrical burn depends on the voltage, current flow and tissue resistance. Electrical burns can be divided into two types 1. Caused by Low Voltage Injuries (<1000 V, LVI), 2. Caused by High Voltage Injuries (>1000 V, HVI). [5] {As mentioned by International Electrotechnical Commission (IEC) and its national counterpart}

This study aims to understand the demographic pattern of electrical burn cases in our region, together with the morbidity and management of such burn injuries in our centre.

Material and Methods

This was a retrospective study conducted in the Department of General Surgery, L N Medical College, Bhopal.

Duration

July 2017 to June 2019.

Inclusion Criteria

All electrical burn cases admitted to the hospital during the study period.

Results

A total of 26 cases of Electrical Burn patients were studied.

Discussion

The widespread use of electric power has been related to a rapid increase in fatal and nonfatal injuries. Electrical burns and injuries are the results of currents passing through the body. Temporary or permanent damage can occur to the skin, tissues or major organs. The mortality and morbidity are very high in cases of Electrical burn injuries in comparison to thermal burns. Therefore, the knowledge of the mode of electrical injuries and underlying causes is of prime importance and assists in patient management. The extent of the damage depends on the strength and duration of exposure to electrical current. The domestic power employed in India is 220 V, alternating at 50 cycles (Hertz) per second, and industrial electric power is over 440 V.

Low-tension or domestic appliance injuries don't have enough energy to cause destruction to significant amounts of subcutaneous tissues when this current passes through the body. The entry and exit points normally lie in the fingers, but there can be little damage between these points. The alternating current creates tetany within the muscles. Thus patients often describe how they could not release the electrical appliance until it was turned off. The most dangerous is the alternating current, which interferes with normal cardiac pacing that can cause an arrest. That's why resuscitation should be given promptly to save precious lives.

In high-tension line injuries, the air's extremely rapid heating causes an explosion that usually propels the victim backwards. The flash, however, can last to ignite the patient's clothes and then cause a flame burn. The entry and exit points are damaged, but, importantly, this current can cause huge amounts of subcutaneous damage between these two points, which might cause serious injuries. The damage to the underlying muscles within the affected limb can cause the rapid onset of compartment syndrome. The release of the myoglobins may cause myoglobinuria and subsequent renal dysfunction. There lies a great risk of myocardial damage. Primary amputation may become necessary in case of severe injury through a limb.

In our study, a sum of 26 patients presented with electric burns over a period of two years, which is about 28.88% of total burn cases admitted during this same period, and this data is comparable to the developing countries as stated by Shih at al, i.e. 27% and also to Indian data given by Shrivastav at al. which is 24.49% [6,3]

In our study Male: Female ratio is 3.5:1, Shih et al.15:1and Shrivastav et al.1.5:1 also found male predominance, which may be due to their more outdoor exposure in comparison to females. [6,3]

The maximum number of adults were above 20 years of age, i.e. 17, as this is the earning population who has to move out for the living and are thus much exposed, which is comparable to the mean age by Kurt et al. 26.4, [8]but we also found 6 adolescents exposed to electrical injuries, which might be due to carelessly playing outside and also in slums (low socioeconomic conditions) were wirings are open and lose fitting connections, a similar finding was seen by Mathangi Ramakrishnan at al. who also found 5 cases aged between 15 and 18 years [5]

19 of the injuries affected the hand and arm, which is not mentioned specifically in other papers, and 16 had to undergo some or other surgical interventions, mostly being the debridement, which is following Shrivastav et al., who also found maximum cases were 73.04% of HVI [3]

There are more number of cases which suffered a high voltage injury, which is comparable to most of the studies with hospital stay ranging from a week to more than a month, with mean stay for LVI is 8.28+/-9.09 and of HVI is 27.08+/-12.09 days which is

Table 3 Voltage Injury.

Voltage	No. of Cases	Percentage
High Voltage Injury	16	61.53
Low Voltage Injury	10	38.46

Table 4 Affected Area.

Affected Area	No. of Cases	Percentage
Hand	13	50
Arm	6	23.07
Leg	3	11.53
Back	2	7.69
Head and Neck	1	3.84
Chest	1	3.84

Table 5 Mode of Injury: Mode of injury was Accidental in all cases and was further recorded under the following heads.

Place of Accidents	No. of Cases / Percentage	LVI / HVI
Home	10 (38.46)	8/2
Outdoors	10 (38.46)	2/8
Industrial Settings / WorkPlace	6 (23.07)	0/6

Table 6 Management.

Management	No. of Cases / Percentage	LVI/ HVI
Conservative	10 (38.46)	9 / 1
Surgical	16 (61.53)	1 / 15

Table 7 Surgical Management: There were 3 number of cases who underwent multiple procedures.

Surgical Management	No. of Cases / Percentage	LVI /HVI
Debridement	5 (31.25)	4/1
Fasciotomy	2 (12.5)	1/1
(with debridement)	3 (18.75)	1/2
Split Skin Grafting	2 (12.5)	2/0
Flap Cover	2 (12.5)	1/1
Amputation	2 (12.5)	0/2

Table 8 Total Duration of Stay.

Total Duration of Stay	No. of Cases / Percentage	LVI / HVI
<3 days	5 (19.23)	5/0
4 – 8 days (1 week)	10 (38.46)	7/3
1 Month	6 (23.07)	2/4
>Month	5 (19.23)	0 / 5

much more to mean stay for HVI, i.e. 14.94+/-7.29 by Shrivastav at al. [3]

In our study, we found that all injuries were accidental, with 10 cases suffering domestic mostly LVI and outdoor electrical injuries with exposure to high tension lines as inquired in case history, and 6 were on their duty at industrial sites /workplace, which is mostly HVI and is accounting to 23.07% which is still very low when compared to Shih at al. study which mentions it to be 75% [6]

Conclusion

Accidental electrocution generally occurs because of carelessness, ignorance, haste, malfunction of appliances or equipment such as ineffective insulation, lack of protective earthing, faulty grounding, and short circuits.

This epidemiological study on the patients of electric burn suggests that most of the human and economic losses caused by the accidents leading to electric burn injuries were young males hailing from rural areas and suffering high voltage burns, which could have been prevented by the implementation of safety measures at workplace.

Hence general education regarding safety measures while using electricity should be given in primary schools itself. In addition, high voltage electrical transmission cables should be placed underground.

Funding

This work did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

References

1. Kalra GS, Sharma A, Rolekar NG. Changing trends in electrical burn injury due to technology. Indian J Burns 2019;27:70-2

2. Ann Burns Fire Disasters. 2013 Sep 30; 26(3): 121–125. Commentary - Safety clearance of high voltage power lines

3. Srivastava S et al. Int J Community Med Public Health. 2018 Jul;5(7):2786-2790

4. Ajay Lunawat, S. M. Datey, Avinash Vishwani, Yashasvi Khare, Vikrant Ranjan Epidemiology and outcome of electric burns at saims, a tertiary care centre of central india

5. Mathangi Ramakrishnan K., Babu M., Mathivanan, Ramachandran B., Balasubramanian S., & Raghuram K. (2013). High voltage electrical burn injuries in teenage children: case studies with similarities (an Indian perspective). Annals of burns and fire disasters, 26(3), 121–125.

6. Shih JG, Shahrokhi S, Jeschke MG. Review of adult electrical burn injury outcomes worldwide: An analysis of low-voltage versus high-voltage electrical injury. J Burn Care Res. 2017;38(1):293– 8

7. 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.

8. Kurt A, Yıldırım K, Yağmur Ç, Kelahmetoğlu O. Electrical burns: Highlights from a 5- year retrospective analysis. Ulus Travma Acil Cerrahi Derg. 2016;22(3):278-82.

9. Aggarwal S, Maitz P, Kennedy P. Electrical flash burns due to switchboard explosions in New South Wales- a 9 year experience. Burns. 2011;37:1038- 43.

10. Hunt JL, Sato RM, Baxter CR. Acute electric burns: current diagnostic and therapeutic approaches to management. Archives Surg. 1980;115:434-43. 6. Navarrete N, Rodriguez N. 5tr454d 'Epidemiologic characteristics of death by burn injury from 2000 to 2009 in Colombia, South America: a population based study. Burns Trauma. 2016;4:8