



Mortality due to Electrical Injuries in the Paediatric Age Group

Author

Dr Pavan P N

Assistant Professor, Department of Forensic Medicine and Toxicology,
Kanti Devi Medical College and Research Hospital, Mathura

*Corresponding Author

Dr Pavan P N

Abstract

With the wide spread use of electricity at home and work place, the number of people sustaining electrical injuries is on the rise. The paediatric age group constitutes a small proportion of all electric burn injuries cases; however due to their young age it is often associated with significant morbidity and long-term psycho-social implications. The present study attempts to know the demographic distribution, place of occurrence, pattern of electrical injuries, regions predominantly affected, associated injuries, mortality periods and causes of death in the paediatric age group i.e. 1 month to 14 years. A total of 33 cases of death by electrical injuries were reported over a period of 5 years. The findings in this group have been represented in this study with males in the age group of 7 to 14 years being affected the most. Most of the deaths have occurred outside the home of the unfortunate children, on the streets and public lands where high voltage currents are prevalent. The upper limbs were commonly affected, contact marks seen in maximum number of cases. One third of the cases died instantaneously primarily due to burns shock. The disregard to safety measures, lack of concern and standards with regards electric infrastructure, by the civic bodies and the people in general, has lead to the loss of innocent lives. The cost of negligence by the public should not be borne by children.

Keywords: *electrical injuries, paediatric age group, burns, voltage.*

Introduction

Electrical burn injury is classified into one of two groups, low voltage (less than 1000 V) and high voltage (more than 1000 V) with the former associated with the home where electrical cords can be bitten, particularly by younger children. High voltage injuries are a serious problem in adolescent boys engaging in high risk behavior around power lines or from lightning strikes. Both forms of injury carry serious morbidity as measured by permanent defects, amputations or operative procedures, with instances of death

being from cardiac arrest following acute cardiac arrhythmias at the scene¹. Young children, particularly toddlers, can experience electric shock when they bite into electrical cords or poke metal objects such as forks or knives into unprotected outlets. These injuries can also occur when electrical current makes contact with water in which a child is sitting or standing². Oral burns are common following the frequent incidence of children inserting a live electrical cord into the mouth³.

Materials and Methods

The study was conducted on pattern of deaths due to electrical injuries brought to Victoria and Bowring and Lady Curzon Hospital, Bangalore during a period of over 5 years (June 2012 – Oct 2017). Lightning strikes have been excluded from this study. Data was collected from the police inquests, autopsy reports and photographic evidence from the scene of occurrence. Reports of specimens of skin with the contact marks and internal organs sent for histopathological examination were analysed. Hospital records were referred to in case of any ambiguity.

Data was reviewed retrospectively and details of demographic data, mode of injury including voltage, body regions involved, associated injuries and causes for such adverse outcome (death) were collected. The regions where the electrical injuries were predominantly seen, the injuries associated either directly or indirectly as a result of such electrical injuries were noted. The causes of death in such cases were analysed. The quantitative data have been expressed in proportion and percentages.

Observation

Demographic Characteristics

The youngest patient was aged 10 months and the oldest was aged 14 years with a mean age of 8.66 years. Incidence of high voltage electric burn injuries increased with increasing age. Boys were more commonly affected than girls with an overall male : female ratio of 5.6:1. 28 boys (84.84%) were involved compared to 5 girls or 15.16% of the study group.

Table No. 1: Age and sex distribution

Age group	Gender		No. of cases
	Male	Female	
1 month to 1 year	1	1	2
1 year to 7 years	6	2	8
7 years to 14 years	21	2	23

There were 6 (18.2%) low voltage (LV) burn cases and 27 (81.8%) high voltage (HV) burn cases. High voltage burns were more common in older age groups compared to low voltage burns.

Low voltage electrical burn injuries were almost always due to household mishaps while high voltage burn injuries mostly occurred outdoors.

Table No. 2: Place of occurrence and mode of injury

Place	No. of cases
Residence (LV)	6
Street adjoining the residence (HV)	14
Public land (HV)	13

Type of electrical injuries and regions of body involved

Upper extremity was most frequently involved followed by lower extremity, trunk and head including neck and face. Involvement of multiple regions was almost the norm in High Voltage injuries, but less common in Low Voltage injuries. The number of cases depicted in Table No. 4 shows those cases where the burn injuries were exclusively seen in these areas. Most cases had multiple areas involved or contiguous areas been involved.

Table No. 3: Type of electrical injuries

Type of electrical injuries	No. of cases
Contact mark only	8
Only flash burns seen	14
Contact mark and flash burns seen	10
No contact mark / flash burns seen	1

Table No. 4: Case distribution according to site or region of electrical injury

Area involved	No. of cases
Upper extremities	8
Lower extremities	4
Abdomen	3
Chest	4
Head	4

Associated injuries

Several victims had concomitant injuries and it was obligatory to look for such injuries. Secondary burning of clothes occurred in 7 cases where the victims had burn injuries in addition to the electric burn injuries. Three patients had fractures of the skull, four patients having fracture of head of humerus and three having fractures of the neck of femur. Elbow dislocation noted in one case. Small hemorrhages noted in the pericardium

and/or endocardium in twelve cases and eight cases showed intraparenchymal hemorrhages in the brain.

Mortality time periods

Treated	22
Instantaneous deaths	11

Cause of death	No. of cases
Shock	16
Septicaemia	15
Head injury and shock	2

Discussion

33 cases of deaths due to electrical injuries in the paediatric age group were studied for a period of over 5 years. They represent a vulnerable section of the society and hence it is necessary to take extra care in their upbringing.

The paediatric age group was divided into 3 subgroups, 1 month to 1 year, 1 year to 7 yrs and children more than 7 yrs. The reason being in the first group, the child is less mobile, cannot be taught about electricity and its dangers, commonly involves another person and only careful vigilance by the parents can prevent any electrical mishap. The second group can be educated about the dangers of electricity, however a careful watch over the child is still necessary and should be exercised. The age group of 7 to 14 years is that of intense activity. Motivation and education about the benefits, usage and dangers must be taught in schools and at home. It is this age group that is maximally affected in this study. This finding is consistent with the findings of other workers^{1,3}.

Majority of the victims were males in the age group of 7 to 14 years. An increased propensity to taking risks and increased outdoor activity may be a contributing factor. This finding is consistent with the findings of an Indian study⁴.

All cases reported were accidental by nature. No suicidal or homicidal cases were reported.

Street adjoining the residence and public lands were the places where most cases of electrocution occurred and these are places where high voltages (>1000 v) are present. 'Street adjoining the residence' included those areas outside the home,

roof tops, balcony, trees and even kite flying⁵. Here the author would like to place the liability on the civic bodies and members of the public who place high voltage electric lines haphazardly without taking precautions on insulation.

Low voltage was involved in 6 cases i.e. 18.2% of cases while the majority i.e. 81.8% of the electrical injuries were caused by high voltages. The term 'low' voltage can be misleading as it may denote voltages which are less life threatening. However, this does not hold true. Low voltages are less than 1000 v. There have been instances where the fatal voltage as been as low as 42 volts⁶. The lethality of electricity does not depend on voltage alone but many other factors like amperage, resistance offered by the body etc.

Contact marks included both entry and exit marks. Entry marks included Joule burns, Flash burns and electric splits, the last not seen in the current study. Entry / exit marks only were noted in 8 cases, flash burns only were noted in 14 cases and contact and flash burns were noted in 10 cases. One case where a boy was electrocuted in a pool of water was also documented which had no electric injury marks, histopathological examination of the internal organs and evidence from the scene of death were suggestive of electrocution. Water reduces skin resistance, thereby increasing the amperage flowing through the body⁷. A study done by Sachil Kumar et al⁸ showed the incidence of 'no electric burn marks' to be 11.9%. However this study had no age limits.

The area of distribution involved by location was similar to that in adults as described in many popular textbooks^{9,10}. The percentage area of electric burns tend to be less when compared to other thermal burns, hence they have not been included in this study. In this study, the upper extremities alone were involved in 8 cases (24.2 %). This is low compared to a study done by Glatstein MM et al¹¹ where the upper extremities were involved in 72% cases.

22 children or two third of the cases were treated for periods varying from as little as 30 minutes to 7-8 days before succumbing to their injuries. The remaining one third had instantaneous unfortunate deaths. This finding is similar to a study done in Manipur on mortality due to electrocution¹².

Burns shock or just 'shock' in electro-thermal injuries can be due to multiple reasons like myocardial failure¹³, ventricular arrhythmias (cardiogenic), loss of plasma volume (hypovolemic) or neurogenic⁹. Most deaths in this study have been attributed to this cause. Secondary infections result in severe sepsis and shock and this has been the second most common cause for death in this study. Two cases of head injury and shock were reported.

Conclusion

No age group is exempt from electrical burn injuries. A total of 33 cases were reported for autopsy in 5 years. Majority of the victims were in the age group of 7-14 years belong to the male sex, commonly electrocuted by high tension wires. Electrical burn injuries are a preventable danger, more so in the paediatric age group. The importance about safety measures like electrical socket guard covers, increased height of the sockets from ground level, improving health infrastructure, and strict adherence to safety regulations with respect to placement and maintenance of power lines should be given due importance.

References

1. Celik A, Ergun O, Ozok G. Pediatric electrical injuries: a review of 38 consecutive patients. *Journal of Pediatric Surgery*. Aug 2004; 39(8) :1233–7.
2. Rabban JJ, Blair JA, Rosen CL, et al. Mechanism of paediatric electrical injury. New implications for product safety and injury prevention. *Archives of Paediatric and Adolescent medicine* 1997;151: 696
3. Baker MD, Chaviello c, Household electrical injuries in children. *Epidemiology and identification of avoidable hazards. American journal of Diseases of children*, 1989; 143:59.
4. S. Srivastava, A. N. Patil et al. Paediatric electrical burn injuries: experience from a tertiary care burns unit in North India. *Annals of Burns and Fire Disasters*, 2017 Sep; 30(3): 185–188.
5. Tiwari VK, Sharma D. Kite-flying: a unique but dangerous mode of electrical injury in children. *Burns*. 1999 Sep; 25(6) :537-539
6. Paul Giovinazzo, The Fatal current, *OSU Physics, Ohio State University Bulletin*, Feb 1987; 2(13).
7. B. Bailey, S. Forget, P. Gaudreault. Prevalence of potential risk factors in victims of electrocution, *Forensic Science International*, 2002; 123: 58-62
8. Sachil kumar, Anoop K. Verma, Uma Shankar Singh. Electrocution-related mortality in northern India – A 5-year retrospective study. *Egyptian Journal of Forensic Sciences*, March 2014, 4(1): 1-6
9. Reddy K S N, *Essentials of Forensic Medicine and toxicology*, 33rd Ed, 2014: 330-333
10. Vij.k, *Text book of Forensic Medicine and toxicology*, 4th Ed, Elsevier,2008: 238
11. Glatstein MM et al. Pediatric electrical burn injuries: experience of a large tertiary care hospital and a review of electrical injury. *Pediatric Emergency Care*. 2013 Jun; 29(6): 737-40
12. Soreingam Ragui, Meera, Pradipkumar Singh, A study of electrocution deaths in Manipur, *Journal of Medical Society*, 2013; 27 (2); 124-126
13. Thomas Oliver, Robert Bolam, Cause of death by Electric Shock, *British Medical Journal*. 1898 Jan; 1(1933): 132–135.