

Study of Electrical Injuries in Fatal Cases in Tertiary Care Hospital

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Abstract

Background and Objective: With wide spread use of electricity at home and work place the amount of electrical related injuries are on the rise. The present study attempts to know age, sex distribution pattern of electrical injuries, cause of death, manner of death, and Histopathological changes in skin with electrical contact mark and in internal organs.

Methods: Study was conducted on deaths due to electrocution brought to Osmania General Hospital mortuary during the period of one year. Specimen of skin with contact mark and internal organs like heart, kidney was sent for Histopathological examination. Data from police reports and picture evidence from the site of the accident were retrieved.

Result: Total number of 60 cases was studied in one-year period. Much of the casualties were men, belonging to the working age community. 58% of victims died instantaneously due to shock. 37% of the fatalities were due to complications of severe flash burns. High voltage electrocution constituted 56.66 % of cases. Low voltage electrocution constituted 43.33%. High voltage electrocution was identified as flash burns, low voltage electrocution was identified as contact mark. Typical Histopathological changes were seen in skin and heart specimen sent for examination. Histopathological changes in kidney were nonspecific.

Conclusion: The diagnostic parameters for electrocution are the electrical contact mark. Histopathological changes were used as supportive evidence in determining cause of death. Human negligence, electrical defective appliances and connexions and lack of safety precautions were the key factors for electrocution death.

Key Words: Shock, High voltage, Low voltage, Flash burns, Electric contact mark, Septicaemia.

Introduction

Electricity is essential in life that without it life is hard to conceive. But the benefits and convenience of electricity are often correlated with the dangers. Electricity can often result in morbidity or mortality, both of which are via accident.¹⁻⁵ Electricity has also been used for suicide reasons in extreme situations⁶⁻¹¹ and

homicidal purposes.² Deaths attributed to electrocution around the world display a distinct trend. Accidental fatalities from electrocution are not prominent in the west because of strong protection and high awareness. Many suicide reports have been registered, however. Accidental deaths from electrocution are more frequent than suicide deaths, despite this in developed countries like India. The typical domestic supply of AC current in India ranges from 220-250 volts, compared to 110 volts in western countries and for industrial use in India its 440 volts.

There is as much risk as electricity is used. It is a threat. Accidents and injuries due to incompetence and

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inability to enforce effective protocols are unavoidable. Electricity has now become an integral aspect of our way of life, unavoidable, invaluable yet harmful. The lowest recorded electrical shock death voltage is 38 volts.¹² In residential, commercial, and industrial settings, electrical injuries can be prevented by following specific guidelines, incorporating electrical appliances and even by enforcing electrical protection regulations properly.

If electrical shocks trigger accidental death, the police can focus most or entirely on medical reports to decide causes of death. Doctors are the key source of proof for the decision-making process. The key purpose is to ascertain the facts, the cause, and the manner of death in the event of an electrocution, and to decide whether death was due to negligence or accident.

It is impossible to determine the absolute cumulative number of electric injuries because of the number of non-fatal incidents. This research is confined to fatal electrical events. In certain cases, the characteristics of electrical contact were lacking, which contribute to the hunt for diagnostic electrocution criteria.

It is also impossible to prove that a man has been electrocuted and there could be no marks from electrocution, but forensic pathologists ought to know about the fatal effects of electricity in order to help the investigation of those incidents.

Methodology

Place of Study: The present study involves study of electrical contact marks in fatal electrocution cases brought for autopsy to Osmania Medical College and

General Hospital. **Study period:** One-year October 2019 to September 2020

Sample Size: 60 electrocution cases

Inclusion Criteria: Subjects included for the present study includes all age group, sexes, incidents occurring at home and work place.

Exclusion Criteria: Cases of electrocution as a cause of death indirectly. For instance, a person falls from height after being electrocuted and dies as a result of head injury.

Statistical Analysis: The statistical analysis was done using SPSS 20 software and data was presented in the form of tables

Methods: Skin with contact mark along with portion of normal skin as control is dissected and sent to Department of Pathology for Histopathological examination. Under the low power and the high-power microscope sections were observed. Observations were made, recorded, and photographed.

In cases where electric contact mark is absent or not evident, internal organs such as heart and kidney were sent for histopathological examination, sections from those organs were examined and observations were made, recorded, and photographed.

The retrograde analysis requires the gathering from inquest report, the deceased's family and police about electrocution circumstances. Photographic evidence was obtained from the scene of the accident.

Results

Table 1: Distribution of cases according to gender, age group, season and voltage

SEX	NO OF CASES	PERCENTAGE
MALE	50	83.33%
FEMALE	10	16.66%
TOTAL	60	100.00%
AGE GROUP		
1 TO 10 yrs	2	3.33%
11 TO 20 yrs	13	21.66%
21 TO 30 yrs	25	41.66%

Cont... Table 1: Distribution of cases according to gender, age group, season and voltage

31 TO 40 yrs	10	16.66%
41 TO 50 yrs	6	11.66%
51 TO 60 yrs	2	3.33%
61 TO 70 yrs	1	1.66%
71 TO 80 yrs	1	1.66%
SEASON		
Summer	13	21.66%
Rainy	35	58.33%
Winter	12	20.00%
VOLTAGE		
High Voltage	34	56.66%
Low Voltage	26	43.33%

Table 1: Distribution of cases according to gender, age group, season and voltage

Majority of the cases were males accounting 83% and females were 17%. The majority of age group electrocuted was 21 to 30 years with 41.66% followed by 11 to 20 years with 21.66%. Most of the electrocution cases were seen mostly in rainy seasons with 58.33%. Most of the electrocution caused was due to high voltage around 56.66%.

Table 2: Distribution of Cause of Death In Fatal Electrocution Cases and Pattern Of Injuries In Electrocution Deaths

Cause Of Death	No of Cases	%
Shock	35	58.33%
Septicaemia	15	25.00%
Toxaemia	4	6.66%
Coma	4	6.66%
S & H	2	3.33%
INJURIES		
Contact Mark	34	45.94%
Flash Burns	27	36.48%
Contact Mark with Flash Burns	8	10.81%
No Contact Mark/ Flash Burns	5	6.75%

The shock was the cause of death in 56% of the cases and followed by septicaemia with 26%. Most injuries were due to contact mark with 45.94% and flash burns seen in 36.48%, contact mark with flash burns with 10.81% and only flash burns with no contact mark seen in 6.75% of the cases.

Table 3: Distribution of Cases with Histopathological Changes in Organs

Organs	Total Specimen	HPE Changes Seen	Percentage
Skin	35	35	100%
Heart	35	17	48.57%
Kidney	35	22	62.85%

The histopathological changes due to electrocution was seen in skin in 100% of the cases followed by kidney and heart with 62.85% and 48.57% respectively.

Cause of Electrocution	No of Cases	Percentage
Human Negligence	26	43.33%
Faulty Equipment's & Connections	18	30.00%
Lack of Protective Measures	16	26.66%

Table 4: Distribution via Cause of Electrocution

Majority of the cause of electrocution was mostly due to human negligence with 43.33% followed by faulty equipment's and connections and due to lack of protective measures in 30% of the cases

Table 5: Pattern of Electrical Injury with Respect to Voltage

Voltage	Total Cases	Flash Burns	%	Contact Mark	%
High Voltage	34	27	79.41%	7	20.58%
Low Voltage	26	4	15.38%	22	84.61%

Table 6: Voltage Distribution in Work Place and Home

Place	Voltage	Total Cases	Cases Found	Percentage
Work Place	High Voltage	34	20	58.8%
	Low Voltage	26	14	53.84%
Home	High Voltage	34	8	23.52%
	Low Voltage	26	10	38.46%

Majority of the electrocution cases occurred at the work place and mostly due to high voltage and low voltage. With 59% and 54% respectively.

Discussion

Number of cases being 60 in a span of 1 year is a significant number compared to earlier studies, where 220 cases were reported in 22 years¹³ and 36 cases were reported in 3 years¹⁴ in which all cases were males as compared to present study where 83.33% of victims were male. Age group most affected is the working class, which suggests that electrocution deaths are occupation related deaths. 56.66% of deaths from high voltage occurred on job as compared to 86% in earlier studies.¹³ 57% of deaths from low voltage were on job as compared to 45% in earlier studies.¹³ 21% of deaths from high voltage occurred at home. 39% of deaths from low voltage occurred at home. Electrical accidents involving high voltage form 54 % and Low voltage form 46 % of total electrocution. Flash burns are present in 78%, while contact mark is present in 30% of cases of high voltage accidents. Contact marks are present in 89%, while flash burns are present in 11% of cases of low voltage accidents. The above statistic indicates that high voltage electrocution invariably present as flash burns and low voltage electrocution present with contact mark in correlation with findings of Wright and Davis,¹³ Vincent D Maio.¹⁵ 56 % died instantaneously due to shock as against 88.9%.¹⁴ 35 % died due to complications of flash burns. 8 % died due to head injury consequent upon fall. 1% died due to shock and hemorrhage. All the cases were accidental electrocutions unlike observations made by Trubner and Puschel,¹⁶ R.K. Wright and J.H. Davis.¹³ Except for petechial hemorrhages over surface of heart, no specific gross internal findings of organs was observed at autopsy, which is in correlation with Bernard Knight's observation.¹⁷ Maximum number of cases was seen in rainy season, which suggests that wet surface plays major role in electrocution as against findings of R.K. Wright and J.H. Davis¹³ where there is predominance of cases in summer. Six cases of electrocution presented with neither contact mark nor flash burns. Death due to electrocution was confirmed by supportive Histopathological changes in skin, heart and kidney. Histopathological changes were seen in the, entire skin specimen, which had contact mark. Textbook description of vacuolation and honeycomb¹⁸ appearance

in the layers of skin was not observed. Instead, breach or break in epidermis along with separation of epithelial cells adjacent to breach is seen with vertical orientation of nuclei, which is in correlation with findings of Tedeschi,¹⁹ Bernard Knight,¹⁷ Ludwig,²⁰ Herbert Fischer.²¹ In India voltage that is supplied for domestic purpose being 220v is higher when compared to that in western countries where it is 110v. This may be cause for separation of epithelial cells and absence of honeycomb appearance. Histopathological finding in heart, which includes wavy appearance of myofibrils, is in correlation with the literature available.¹⁷ Sections showed stretching of myocardial fibres along with elongation and wavy appearance in 47% of specimen sent. Histopathological finding in kidney is non-specific and suggests disseminated intravascular coagulation, present in 61% of cases, correlates with findings of Bernard Knight.¹⁷ In few cases, petechial haemorrhage was found along the margins of lungs, which was sent for Histopathological examination. Histopathological findings showed congested vessels and foci of haemorrhage. In cases where contact marks were evident, Histopathological findings were used as supportive evidence for cause of death. In cases where no contact marks were found, positive Histopathological findings were used to give the cause of death as electrocution. Causes of electrocution were investigated and found that human negligence was main cause of electrical accidents (41%), faulty electrical equipment's and connections contributed to 31 % of accidents and lack of protective measures caused 28 % of electrocution, which agrees with study done at Armed Forces Institute of Pathology.²²

Employees of electrical work even though provided with protective gloves, harness, belts were negligent of not using the same and they should ensure that main line should be devoid of current supply while they are working.

Domestic accidents, which consists 28% of total electrocution, are due to faulty electrical equipments or connections and human negligence. One fourth of domestic accidents occur in bathrooms involving boiler switches and immersion coils. Another important cause observed was contact with live wire while drying of wet cloths over metal wire (one fourth of total domestic cases) in correlation with Theodore Bernstein study.²³

Houses constructed illegally with close vicinity to high-tension wire lead to electrical hazard with the dwellers. Short circuit with television cable wire has led to electrical accidents to people who tried to connect the cable wire.

Conclusion

The diagnostic parameters for electrocution are the electrical contact mark. Histopathological changes were used as supportive evidence in determining cause of death. Human negligence, electrical defective appliances and connexions and lack of safety precautions were the key factors for electrocution death.

Ethical Clearance: Ethical clearance was obtained from our College institutional ethics committee i.e Osmania Medical College and General Hospital prior to the commencement of the study.

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