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Deaths Due to Electrocution in Central India: A Study of Two Years

Umesh Kumar Choudhary[1], Vinod V Rathod[2], Pankaj S Ghormade[3], Ajay N Keoliya[4]

[1]Assistant Professor, Department of Forensic Medicine & Toxicology, American International Institute of Medical Sciences, Udaipur, Rajasthan, India, [2]Assistant Professor, Department of Forensic Medicine & Toxicology, V M Government Medical College, Solapur, Maharashtra, India, [3]The then Assistant Professor, Department of Forensic Medicine & Toxicology, Government Medical College, Nagpur, Maharashtra, India, [4]The then Professor and Head, Department of Forensic Medicine & Toxicology, Indira Gandhi Government Medical College, Nagpur, Maharashtra, India

Abstract

This study has been carried out to find out the incidence of deaths due to electrocution in Nagpur with special emphasis on finding out the circumstances along with pattern of injuries sustained by the victims. Medico legal autopsy cases with history of electrocution over period of 2012 to 2013 were included in this study.

A total of 74 deaths due to electrocution were studied in which male's outnumbered females. Approximately half of cases was observed in the age group of 21-30 years (36 cases i.e 48.64%) which included 05 females. More than 2/3rd i.e 56 victims (71.6%) were electrocuted by low tension domestic supply, out of which 38 were electrocuted at home. 18 victims (24.4%) were electrocuted by high tension current. Only 03 victims survived for period of 24-48 hours whereas 71(95.9%) victims died on the spot. In half i.e 52.4% of the cases only entry wound was present, followed by presence of both entry and exit wound in 36.4% cases. Information gathered from police documents and history by relatives revealed that almost all of the electrocution deaths were because of accidental electrocution, only two suicidal cases were observed. Most common histo-pathological finding was focal separation of dermis and epidermis, epidermal nuclear elongation and palisading. The risk of getting electrocuted in domestic surroundings from the haphazardly installed electric wires without proper maintenance is indeed a matter of concern. Adoption of proper insulation safety measures are important factors required for prevention of fatal electrocution.

Keywords: *Electrocution; Domestic supply; Accidental; Suicide; High tension wire.*

Introduction

Electricity is such an integral part of modern life, that it is hard to imagine life without it. But, with the advantages and convenience of electricity come the hazards as well.[1]

Corresponding Author:
Dr. Umesh Kumar Choudhary
Department of Forensic Medicine & Toxicology,
American international institute of medical sciences,
Udaipur, Rajasthan, India (313001)
Email: ukc2307@gmail.com, Cell: 07742542307

Electricity is a ubiquitous energy agent to which many workers in different occupations and industries are exposed daily in the performance of their duties. In addition, many people in different daily activities deal with it.[2]

The use of electricity may result in cases of morbidity or mortality[1] which are usually preventable with simple safety measures. Almost all fatalities by electrocution are accidental, while homicides and suicides from electricity are rare or uncommon.[3]

The National Electrical Code describes highvoltage as greater than 600 V AC. Most utilization circuits and equipment operate at voltages lower than 600 V, including common household circuits (220/240 V).[4]

Death due to electrocution involves both low- and high-voltage currents, however, most deaths are due to low-voltage currents used in houses and minor industrial settings. The type of power system employed in India is an AC 220–240 V, 50 A.[5]

A distinct pattern is seen in deaths due to electrocution all over the world. In the Western world, accidental deaths caused by electrocution are not common owing to the good safety measures and high level of awareness. However, many cases of suicides are reported. As against this, in developing countries like India, accidental deaths caused by electrocution are far more common than suicidal deaths.[1]

Fatal injuries caused by electricity do occur and can present a challenge for the forensic pathologist performing the autopsy. One of the crucial signs on the body of a person who suffered a fatal injury from electric current is an electrical mark, which is often the only evidence of contact with electricity. There is a great diversity in the prevalence and appearance of electrical marks. Due to possible absence of distinctive morphological findings on the body, electrocution as a cause of death is often established by exclusion of other possible causes and supported by circumstantial evidence collected at the scene of the incident. [5]

In this study, we analyzed the prevalence of electrical marks on examined victims of electrocution and other available information about the fatal event in Nagpur which is a rapidly developing and expanding city of Maharashtra leading to increased use and dependence of population of Nagpur on electric appliances. This study: highlights the magnitude of the problem of home and occupational accidental electrocutions in Nagpur, and provides recommendations for developing effective safety programs to reduce the risk of electrocution. It is hoped that this study will serve as a valuable resource for safety and public health professionals, trainers, researchers, and others who can affect the prevention of accidental electrocutions.

Material and Method

An observational prospective study was done on unnatural deaths from Nagpur, which were autopsied at Dept. of Forensic Medicine & Toxicology, Indira Gandhi Govt. Medical College, Nagpur, India. Of the 3435 cases performed on all types of unnatural deaths between 1 January 2012 and 31 December 2013, 74 deaths (2.15%) were due to electrocution. These 74 electrocuted cases form the material of this study

For the purposes of this study, electrocution deaths were divided into two categories i.e due to low-voltage(<600 V) and high-voltage (>600 V). Lightning-related deaths were excluded from this study. General information about these cases was collected from the history, the police papers and post mortem reports. This information was then entered in a proforma made for this purpose and there after analysed. The cases were evaluated in terms of age, sex, type of electric mark, body region distribution, place and season of occurrence, contact details, the duration of hospitalization before death, the manner of death and potential risk factors for fatal injury.

Results

Out of total 3435 cases 74 deaths (2.15%) were due to electrocution in which male's outnumbered females (62 males:12 females, ration 5.17:1). The highest number of cases was observed in the age group of 21-30 years (36 cases i.e 48.64%) in which only 5 were females. 56 victims (71.6%) were electrocuted by low tensions domestic supply out of which 38(67.8%) were electrocuted at home by iron, switches, cooler and other household appliances. 18 victims (24.4%) were electrocuted by high tension current. 03 victims survived for period of 24-48 hours while 71(95.9%) victims died on the spot. 59 (79.73%)victims were electrocuted in dry conditions. In most of the cases i.e 52.4% only entry wound was present, followed by presence of both entry and exit wound in 36.4%. In 01 case there was no entry or exit wound. Most common part of body involved was upper limbs. As per police documents and history by relatives most of the electrocution deaths in the present series were accidental cases and two suicidal cases were noted. Most common histopathological finding was focal separation of dermis and epidermis, epidermal nuclear elongation and palisading. Metallic residues was present in 02 cases.

Discussion

In this study males accounted for a major number of fatalities (83.8%), similar result was observed with the work of other researchers[1 - 16].

Most of our cases fell in the age group of 21 – 30 years (48.65%). This finding is also in consistency

with the work of others[6,7,8,11,13,14,15,16] though Rautji et al[8] narrowed down the range to 21-40 years and Dokov classified age group as 25-44 years similar to work of other researchers[1,2,3,4,5,12]. Surprisingly, the age group of 0-10 years was also not spared. In our study there were 4.05% cases in this group while in another studies from India Bharat et all[14] reported 4.8%, Ananda Reddy et al[16] reported 18 per cent and from the one in Turkey it was 31.7%.[3]

In the present study, electrocution deaths accounted for 2.02% of total, while Rautji et al[8] reported the figure of 1.98 per cent and Tirasci et al[6] reported 3.3%. In terms of deaths due to electrocution per one lakhs population the figure turns out to be 4.4. This is significantly higher when compared to studies done by Dokov et al[10] in Bulgaria and Laupland et al[12] in Canada who reported the figures of 0.94 and 0.14 respectively. The average number of fatalities reported by Dokov et al[10] was 35 in the span of 22 years, while in our study it was about 37 per year. Obviously many factors like more population, more illiteracy amongst the general public, lack of awareness about the hazards of electricity, poor maintenance of equipments and wire linings etc. must have been responsible for this difference.

We observed that most common part of body involved was upper limbs which is consistent with findings of other researchers[1,2,3,4,5,6,13,14,16].

In our study, in 33(43.33%) cases, only entry marks were seen and both entry and exit marks were seen in 22(30 %) cases. In contrast to the findings of the other worker[1,2,6,11,13,16] who had figures as high as 72 % for cases with both entry and exit marks. In our study there was 01 (1.67%) cases lacking a mark of electrocution. Such cases were seen in the rainy season, first being the easy passing of current in damp material and second the lowered resistance of skin of the victims due to wetness or dampness. In such cases the cause of death was ascertained by inference after full legal and medical investigations.

Tirasci et al[3] reported wet cases of electrocution using bathtubs, heaters and hair dryers. However, we did get cases of electrocution due to involvement of water by way of the effects. In fact, the wet surrounding was responsible for 15 (20.27 %) cases in the present study while in 79.73% cases surroundings were dry. This observation is in contrast with findings of B.D Gupta et al[1] who observed 75% deaths in wet surroundings. Approximately 1/3rd deaths i.e 28 (37.84%), were concentrated in three months of the year, namely June, July and August. These are the months of monsoon in this part of the world. These findings are consistent with the findings of other worker[1-6, 10,11,15,16] however Biradar Gururaj et al[8] reported more deaths in months of September to december. Tirasci et al[3] also report maximum number of cases in the months of June, July and August but the season during this period in Turkey is summer rather than monsoon.

Most of our victims 51.35 % suffered electrocution in the surroundings of home similar to observations of many researchers[1,3,5,6,8,10,11,15,16]. Few other researchers[2,6,7,13] observed contrasting results of more electrocution at other locations like workplace. Similar to the observation of researchers[1,2,3,5,6,8,11,13,15] it was observed that 71(95.9%) victims died on the spot.

All deaths, except 02 cases in our study were accidental, the exception was suicidal. This observation is in similarity with that most of other researchers[1-8,13,16] The suicide cases comprised of one case electrocuted by climbing an train engine and other by putting his hand in main power distribution box situated near his house, in both cases eye witness were available.

Most common histo-pathological finding was focal separation of dermis and epidermis, epidermal nuclear elongation and palisading which are similar findings have been reported by Manish Shrigiriwar et al[7].

Table-1 : Distribution of cases according to age

Age in years	No. of subjects	Percentage
0-10	3	4.05
11- 20	9	12.16
21- 30	**36**	**48.65**
31- 40	13	17.57
41- 50	9	12.16
51- 60	3	4.05
61- 70	1	1.35
Total	74	

Table no. 1 shows distribution of cases according to age. Most common age group was 21-30 years followed by 31-40 years

Table-2: Distribution of cases according to place of incident

PLACE	No. of subjects	Percentage
HOUSE	**38**	**51.35**
WORKPLACE	15	20.27
INDUSTRIAL	1	1.35
ROAD	6	8.11
OTHER	14	18.92

Table no. 2 shows distribution of cases according to place of incident. Commonest place of incidence was house followed by workplace.

Table -3: Distribution of cases according to surrounding of place of incident

CONDITIONS	No. of subjects	Percentage
DRY	59	79.73%
WET	15	20.27

Table no. 3 shows distribution of cases according to surrounding of place of incident. More than 3/4th cases were reported in dry surroundings.

Table-4: Distribution of cases according to voltage

VOLTAGE	No. of subjects	Percentage
HIGH	18	24.32
LOW	56	75.68

Table no. 4 shows distribution of cases according to voltage involved. In 3/4th cases low voltage was the cause of electrocution.

Table-5: Distribution of cases according to site of electrocution mark

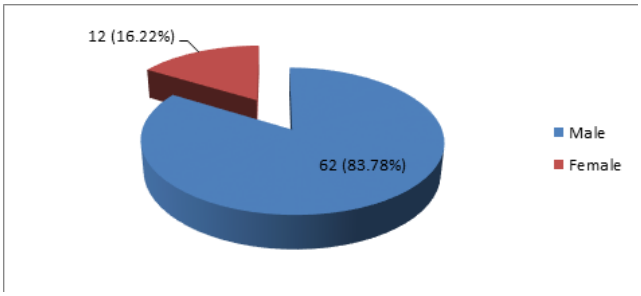
SITE		No. of subjects
HEAD NECK FACE		13
CHEST		8
ABDOMEN		11
BACK		13
UPPER LIMBS	RIGHT	27
	LEFT	26
LOWER LIMBS	RIGHT	13
	LEFT	13
GENITALS		6

Table no.5 shows distribution of cases according to site of electrocution mark. Most common part involved was upper limbs > lower limbs. Table contents injuries present over multiple parts of body.

Table-6: Distribution of cases according to type of injuries present over body

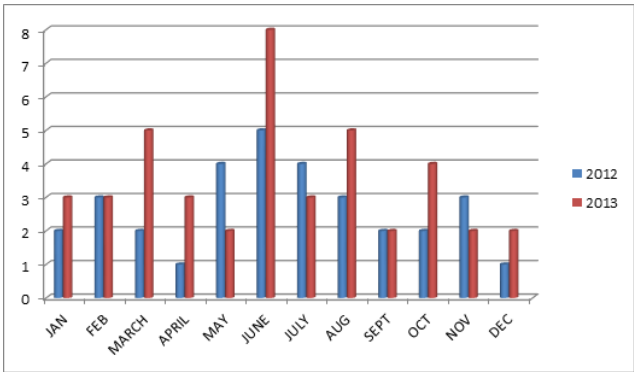
TYPE OF INJURY	No. of subjects	Percentage
NO INJURY	01	1.68
ENTERY WOUND	33	43.33
BOTH ENTERY AND EXIT WOUND	22	30.00
FLASH BURNS	06	8.33
CHARRING	12	16.68

Table no. 6 shows distribution of cases according to type of injuries present over body. Only entry wound was observed in maximum number of cases.



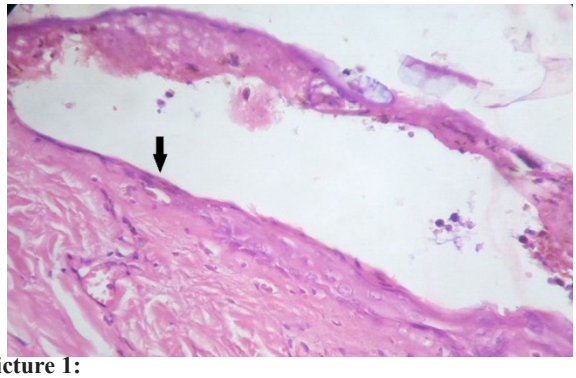
Graph -1: Distribution of cases according to gender

Graph 1 shows gander wise distribution of cases, 83.78% cases were males.

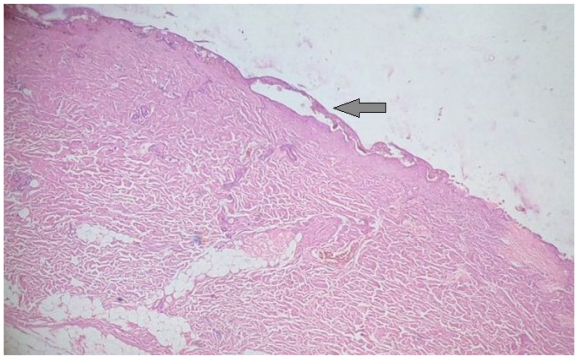


Graph 2: Month wise distribution of study cases.

Graph 2 shows month wise distribution of cases. Maximum deaths occurred in month of June (17.57%) followed by August (10.8%).



Picture 1:



Picture 2:

Most common histopathological findings was focal separation of dermis and epidermis (pic 1), epidermal nuclear elongation and palisading (pic 2).

Conclusion

· Most of the electrocution deaths were accidental,

· Males were the predominant victims.

· In the rainy season, more than 1/3rd deaths occurred.

· Most of the deaths were either instantaneous or immediate.

· Rate of fatality is significantly higher in India as compared to western part of the world

· More than 73.54 per cent deaths occurred in domestic surroundings. It signifies that people living at home did not have elementary knowledge of risks of electrocution.

· Most of the deaths were preventable.

Conflict of Interest – no conflict of interest

Source of Funding- self

Ethical Clearance– approval taken from institutional ethical committee.

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