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Case Report

Death due to electrocution- A rare method of suicide

Ashwini A Bhosale^{1,*}, A. A. Taware¹, V. T. Jadhav¹, Harish S Tatiya¹, A. L. Bandgar¹,
H. V. Vaidya¹

¹Dept. of Forensic Medicine and Toxicological, B J Government Medical College, Pune, Maharashtra, India



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ABSTRACT

Suicide is defined as “the act of killing yourself deliberately”. Most common methods of committing suicide in India are hanging, followed by poisoning, drowning and self-immolation. While least common methods include consuming sleeping pills, electrocution, self-inflicting injuries and firearm injury. Considering deaths due to electrocutions, in India as well as globally, suicidal electrocutions are reported to be very rare compared to accidental ones. Existing literature also have scarcity of reports related to suicidal electrocutions. Hence, we hereby report a case of suicidal electrocution due to its rarity.

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1. Introduction

Suicide is defined as “the act of killing yourself deliberately”.¹ The NCRB report of 2020 states that the most common method of committing suicide nation-wide as well as in Maharashtra is hanging. In the same report, the number of deaths due to accidental electrocution in India stands at 13,446; of which 1499 deaths (11.15%) occurred in Maharashtra. Most of these accidents are caused due to faulty wiring, broken gadgets, wet and damp electrical appliances or simply due to carelessness while handling electrical gadgets. On the other hand, only 629 (0.4%) cases of suicidal electrocution have been reported nation-wide, out of which only 23 (0.1%) were from Maharashtra (Tables 1 and 2).² Also, the incidence of suicidal electrocution in India in the past five years has remained almost the same (Table 1). This clearly shows that suicidal electrocutions are rare compared to accidental ones and reporting of such cases is even more rare.

2. Case Details

A 53-years old man, laundry shop worker, was found in unconscious state, by his friend at his workplace on the morning, with both his wrists tied together with uninsulated copper wire from the electric cord of an iron, connected to a 15 Ampere source of Alternating Current of 220-240 Volts. As per the history given by his son, the deceased, as a daily routine, had left home on the previous night, at around 10.00 pm, after having dinner, to sleep at his laundry shop. The shop was made of tin sheets and had a tin shutter with no other entry or exit point. He was found lying on the platform where he used to iron clothes as seen in the photograph (Figure 1). The crime scene did not show any signs of scuffle. He was declared brought dead at Casualty, Sassoon General Hospital, Pune the same day. The dead body of deceased was sent for post-mortem examination at the Department of Forensic Medicine and Toxicology. Examination of clothes revealed nothing significant. No suicide note was found at the place of incidence or in his clothing. Also, there was no any history of previous suicide attempts.

* Corresponding author.

E-mail address: ashwinibhosale44@gmail.com. (A. A. Bhosale).

On external examination, the deceased was obese and the body was cold. Rigor mortis was present and well-marked in whole body. All limbs were in semi-flexed position. Face, eyes, lips and buccal mucosa were congested. Thin colourless mucus-mixed fluid was seen oozing from left nostril. Post-mortem lividity was present over anterior aspect of neck and chest, antero-medial aspect of arms and thighs except over pressure areas and was fixed.

On local examination, electric burn injury with evidence of hardening and charring of skin was present along whole circumference of right wrist of size 10 cm x 0.5 cm and 0.2 cm deep, grooved area of skin showed greyish green deposit, margins were dark reddish brown and surrounding skin was erythematous. The skin appeared to be split in the grooved area. (Figure 3). Another electric burn injury with evidence of hardening and charring of skin was present along whole circumference of left wrist of size 10 cm x 0.5 cm and 0.2 cm deep, margins were blackened due to extensive charring and surrounding skin was erythematous (Figure 3). Charring was more pronounced over left wrist as compared to right wrist. The skin appeared to be split in the grooved area. There was no evidence of any other injuries elsewhere on the body. On internal examination, there was no any evidence of any other injury and all organs showed congestion.

Skin from electrocution site was preserved and sent to FSL for detection of metallic residues. Normal skin was preserved as control sample. Another sample of skin from electrocution site was preserved in 10% formalin for histopathological examination. Blood was preserved and sent to FSL for chemical and toxicological analysis.

Accordingly, cause of death was given as “Death due to electrocution, articles preserved for analyses”.

The skin sample preserved for histopathological examination after Eosin and haematoxylin stain showed evidence of coagulation of dermal layers with separation of the dermo-epidermal junction in some places. Some areas of the epidermis also showed elongation and stretching of cells. Also, few areas show stretching of the nuclei producing a palisading type of appearance, known as streaming of nuclei along with hyperchromatic nuclei (Figure 4).

Skin sample preserved for detection of metallic residues were positive for copper. Blood preserved for chemical and toxicological analysis was negative for the same.

Table 1: Table showing year wise distribution of cases of death due to suicidal electrocution in india as per data of national crimerecords bureau of respective years

Year	Number of deaths	Percentage
2020	629	0.4
2019	752	0.5
2018	565	0.4
2017	560	0.4
2016	647	0.5



Fig. 1: Photos of deceased from crime scene. Deceased found in unconscious state with uninsulated copper wire found around both wrists.



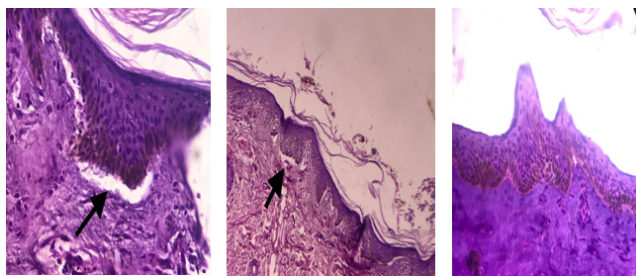
Fig. 2: Photo of disconnected electric wire having uninsulated ends.



Fig. 3: Photos showing electric injuries to both wrists, with evidence of metallisation.

Table 2: Table showing distribution of various methods of suicide in India and in Maharashtra as per data of National Crime Records Bureau, for year 2020.

Sr. No	Method of suicide	Total no of cases in India	Percentage distribution	Total no cases in Maharashtra	Percentage distribution
1	Hanging	88460	57.8	12795	64.3
2	Poisoning	38336	25.0	4461	22.5
3	Drowning	7977	5.2	1414	7.1
4	Other Means	6795	4.4	138	0.7
5	Self-immolation	4603	3.0	399	2
6	Comin under vehicles	2626	1.7	298	1.5
7	Jumping	1843	1.2	278	1.4
8	Consuming Sleeping pills	882	0.6	35	0.2
9	Touching electric wire	629	0.4	23	0.1
10	Self inflicting injury	457	0.3	58	0.3
11	Firearm	444	0.3	10	0.05
12	Total	153052	-	19909	-

**Fig. 4:** Photos showing histopathological changes in the skin sample retrieved from electric injury sites (Haematoxylin and Eosin stain).

3. Discussion

Researchers have suggested that people use methods of suicide to which they have ready access. Work-related access to means is said to be a risk factor for suicide in the employed population.³ Suicide by electrocution is however rare throughout the world.^{4–9} According to a 20-years study conducted by Ivana Kuhtic et al, suicides by electrocution showed an increasing trend over the study period, but their number was too low to determine the significance of the trend.¹⁰ Even in India, rare cases of suicidal electrocution have been reported earlier.¹¹

It requires pre-planning to execute the act and ensure its completion resulting in death. It requires preliminary knowledge about the functioning of electric appliances. Most people who have committed suicide by electrocution had either worked or were currently working as electrician.^{4,7,8} In contrast to this, Kuhtic et al reported that persons who committed suicide by electrocution were of different professions and educational level, but none was a professional electrician. Also, he reported one incidence of occupational electrocution, which was determined as suicide, occurred in a bakery and was committed by a baker.¹⁰

In the present case, the deceased was a laundry person who used to iron clothes for a living, which is not directly related to electrical work. However, in India, in small scale shops and self-owned stores, majority of repairs related to electricity are done by owners to save expenses. This practise leads to cultivation of some basic knowledge about electricity in individuals. Hence in present case, it can be said that he may be having some working knowledge about electricity.

Elderly people have the highest suicide rates in almost every country.^{12–15} While depression, physical illness, and loss are known to precipitate suicidal behaviour in the elderly; only a minority of older people with these risk factors attempt or complete suicide.^{16–19} Suicide by electrocution is also observed more common in the elderly.²⁰ Byard et al in his study on suicide methods in the elderly of South Australia, reported that over a 20-year period from 1981 to 2000, a total of 445 cases were found in elderly of age more than 65 years (13.8% of all suicides), of which 9 were cases of electrocution.²¹

A significant difference was found in the incidence of suicide by electrocution between male and female victims where in 10 men had committed suicide by electrocution whereas only 2 women had used electrocution for committing suicide.¹⁰ Choosing electrocution as a means to commit suicide is more commonly found in males.²⁰ In one particular study, only one female was reported to have committed suicide by electrocution, out of 539 total suicides.²²

A majority of older adults who die from suicide do not have a known mental health condition.²³

In the present case, the victim was a middle-aged male with no known physical illness and no known reason to commit suicide. However, whether he had any undetected mental illness, is a matter of speculation.

Considering suicidal electrocutions, most common method opted was direct contact with low voltage current

live wire used for domestic electrification.^{4,5,8} Similar method was used in the present case. Here, the deceased person was not only in contact with the wire, but he made sure that the current does not stop flowing through his body by wrapping the live uninsulated copper wire around his wrists.

Second most common reported method was touching high voltage power transmission line.⁴ Other common methods includes using bath tub or water body with electrical device immersed in water.^{4,5,7}

Kuhtic et. al., report 4 cases where the victims were found in a water filled bathtub with an electrical appliance (hairdryer in two cases, electrical heater in one case, and undetermined appliance in one case).¹⁰ We could not find any such case reported from India.

Circuits like Hand-to-hand and neck-to-hand, have been reported widely in various studies and case reports.^{7,24,25} In the study conducted by Kuhtic et al, in 7 cases, electrical wires were found wrapped around the parts of the body.¹⁰ In the present case, hand-to-hand circuit was used and electric wire was tied around both wrists.

Electricity is the flow of electrons through a conductor. An object that collects electrons becomes negatively charged, and when the electrons flow away from this object through a conductor, they create an electric current. The force that causes the electrons to flow is the voltage. Anything that impedes the flow of electrons through a conductor creates resistance.²⁶ These relationships can be summarized by Ohm's law: $V=I \times R$ (V = voltage in volts, I = current in amperes, and R = resistance in Ohms).²⁷

Damage by electrical currents is influenced by current, voltage, heat generated, and duration of the electrical flow. Electrical currents entering the body, normally travel the shortest path from the source of contact to the ground contact or exit point. The longer the victim is exposed to the current, the greater the damage will be. Electrical currents passing through the victim can cause sudden death by disruption of neural regulatory impulses. Furthermore, electro-thermal injuries may occur at the source and ground contact points and in inner organs. An electrical injury mark is one of the crucial morphological findings on the body of a person who received a fatal electric shock and it is often the only evidence of contact between the body and electricity.

The most important factor determining the development of electrical injuries is the amount of current that flows through the body or tissue. Other important determinants are resistance, type of circuit, duration of contact, size of contact area, current pathway through the body, and type of electrical contact.^{28–31} The higher the resistance, the higher is the potential for transformation of electrical energy into thermal energy. The resistance is determined by the physical and chemical properties of the material or tissue itself and environmental factors. Moisture decreases resistance, and carbonization during burning increases resistance.³²

Skin (keratin) is the main resistor to the current flow into the body. Typical resistance of dry human skin can reach 100 k Ω or more. Under wet conditions (sweating, rain, showering, bathing), skin resistance may drop to 1 k Ω . Mucous membranes of humans have a resistance of approximately 100 Ω , and internal body resistance is around 300 Ω . Bones, fat, and tendons have highest resistance, followed by skin. The lowest resistances are present in blood, nervous tissues, muscle, and mucous membranes.

In the present case, the skin of the deceased was dry and therefore, electro-thermal injuries were more prominent, resulting in charring and carbonization.

The type of current also influences the extent of damage. Alternating and rotary currents are about 3 times more dangerous than direct current, because they are able to trigger continuous muscle contractions (tetany). Direct currents tend to cause a single muscle spasm, often throwing the victim away from the contact. Alternating or rotary currents tend to induce muscular tetany, immobilizing the victim at the contact, thereby increasing the duration of the current flow. In the current case, alternating current of 220V-240V was used, hence body was not found to be thrown away.^{28–31}

The terms entry and exit wounds are often used to describe electric injuries to the skin. This is true for the unidirectional current flow in DC accidents. However, the terms source and ground contact points are more appropriate in the case of AC or RC accidents.²⁸ In the study conducted by Kuhtic et al, obvious multiple entry wounds (extensive burns excluded) were found in 9 cases, 6 of which were suicides with electrical wires wrapped around various parts of the victim's body (the head, neck, hands, and legs). Multiple entry wounds were also a finding strongly associated with a suicide rather than an accident.¹¹ In the present case, two entry/source contact wounds were present on both wrists with the platform on which the victim was sleeping acting as the ground contact or exit through earthing.

The longer the duration of contact of the victim with electricity, the more energy can cause electrothermal heating of tissues. This increases the degree of tissue destruction at the skin contact points and in inner organs.^{28–31} In the present case, looking at the extent of charring, it can be said that the duration of contact must be long but cannot be commented exactly.

The larger the size of the contact area, the less energy acts upon the tissue per square area. The same current producing thermal necrosis in the skin when the contact is made by a pinpoint electrode may cause no lesions when the contact area is large, which is the usual circumstance in electrocution in bathtub accidents and suicides.^{28–31} In the present case, the area of contact was small and therefore, the extent and depth of electro-thermal burns is more.

Inexplicable early or abnormal regional development of rigor mortis (e.g., affecting only one arm or leg) may hint at electrocution since the tetany from prolonged electrical contact usually accelerates development of rigor.³¹ In the present case, it cannot be said whether the rigor mortis was preponed due to electrocution or if it developed naturally.

Usually, no significant changes are seen on internal examination in cases of deaths due to electrocution. In the present case also, no such changes except for congestion of internal organs were observed. However, Anders et al report a case of an electrician who committed suicide by electrocution using a time switch after oral ingestion of diazepam. Electrodes (coins) were fixed with adhesive tape at the height of the heart to the front and back of the left side of the chest. Autopsy revealed a blackish linear mark on the pleura parietalis of the inner side of the thoracic cavity, connecting the cutaneous current marks. Current-related and heat-related changes, such as hypercontraction bands of the intercostal muscles and coagulative changes of the perineurium of peripheral nerves, were found at histologic examination. Taking into consideration that the body had been under the influence of low-voltage current for 7 days, the morphologic alteration on the pleura parietalis was in accordance with an internal current mark, indicating the main route of current flow through the body.³³

4. Conclusion

Deaths due to electrocution are not uncommon and most of these are accidental, however one should be aware of the fact that, electrocution, though rare, is a novel method of committing suicide. Most of the suicides by electrocution world over are committed by persons having knowledge of electricity, but it is not the thumb rule always. When conducting post-mortem examination in cases of suspected electrocution or where death occurred in suspicious circumstances, the forensic surgeon should not neglect less obvious types of skin marks, like collapsed blisters, erythematous skin, charred epidermis on any part of the body. Careful external examination should be followed by histopathological examination to look for discrete changes in the skin. Also, keen observation during internal examination must be practised.

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None.

6. Conflict of Interest

None.

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- A. A. Taware**, Professor
- V. T. Jadhav**, Associate Professor
- Harish S Tatiya**, Assistant Professor
- A. L. Bandgar**, Assistant Professor
- H. V. Vaidya**, Assistant Professor

Author biography

Ashwini A Bhosale, Junior Resident

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