Case report

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Forensic Investigation and Some Medicolegal Aspects of Electrocution Related Deaths: A Case Study

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Abstract

Electric accidents cause serious injuries by direct heat exposure or by igniting cloth. The severity varies between simple harmless shocks to death. Many at times the victims are thrown to ground from the electric poles sustaining fatal non electric injuries. Diagnosis of death by electrocution may be difficult when electricity passing mark is not visible or unclear. In this study a case of high voltage electrocution is reported and discussed. In this case the victim sustained injuries due to arcing of current and fall from electric pole during scheduled maintenance, there was exit wound in leg indicating the flow of current. The victim suffered from fatal head injuries due to fall. According to forensic aspect, the body of a man who was died from accidental electrocution was carefully analyzed and some medicolegal aspects of electrocution discussed.

Keywords: High voltage electrocution, Arcing of current, Exit wound and fatal fall from height.

INTRODUCTION

Electricity has become an integral part in to the human life from household purposes, industrial works to production of other sources of energy. Electrocution results when a person is exposed to lethal amount of electricity and it involve both high voltage and low voltage currents. Virtually all cases of electrocution are accidental in nature, with suicides rare and homicides even rarer. Electrocution is the cause of death for approximately 1000 people in the India every year. The severity of electrical injuries is dependent upon several factors including voltage, type and current flow, intensity of the electrical current, electrical source, and length of exposure to that source. We hereby report a case of electric fatality and show how danger is the electrical shock in outdoor set up. The purpose of this study was to evaluate the incident circumstances of fatal electrocution cases investigated in order to better assess potential risk factors as well as safety precautions that may potentially reduce or prevent electrocution fatalities and some forensic as well as medicolegal aspects.[1-5]

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CASE HISTORY

A 30-year-old electric lineman had sustained electric shock and burn injuries while repairing high tension wires and was brought dead to casualty. The victim was wearing a cotton shirt and

it caught fire during the incident. On autopsy burn injuries were seen over front of chest, abdomen and anterior aspect of both thighs, which were due to burning of his clothes. A charred and deeply scorched electric mark was found over the lateral aspect of the index finger suggestive of the entry wound of the passage of current. Exit wound was seen over the pulps of the toe at foot. A burn area of size 6x3.5 cm was seen over the plantar aspect of the foot suggestive of heating up of the tissues, dissolution of keratin and separation of epidermal-dermal layers by the current. A deeply scorched wound was seen over the medial aspect of left foot. In this case the exit wounds are single and seen in the left foot, indicating that the passage of the current is in single direction. On opening the cranial cavity, extradural hemorrhage was seen over the left parieto-temporal area. Diffuse subarachnoid hemorrhage was seen in the left cerebral hemisphere along with contusion of the temporal lobe without any fracture of the skull. (Fig. 1-3)

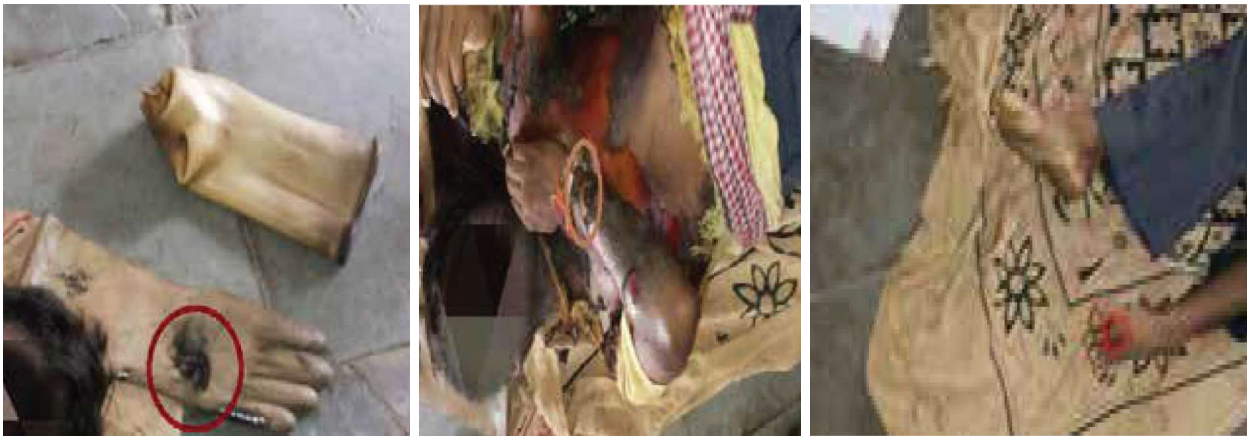

Fig. 1. Passage of current across the right hand and exit through feet

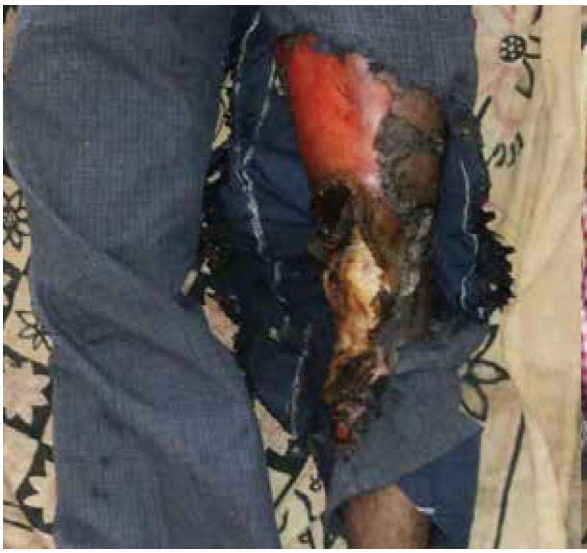

Fig. 2 Thermal burn injuries

Fig. 3 Contusion of the temporal lobe without any fracture of the skull

Medicolegal aspects of electrocution

Fatal electrical injuries may occur in various ways. Direct contact with electricity, electrical arcs, and flash burns created by an electrical arc, or flame burns. They are mainly preventable with simple safety measures in most situations. Deaths due to electrical energy is a "functional" death type in most cases, because severe injuries may happen as a result of cardiac arrhythmia / ventricular fibrillation, asphyxia, or electrically induced respiratory muscle contractions. Internal findings are nonspecific and may include bone fractures, nerve damage, tissue burns, and kidney injury. Therefore, autopsy findings from sudden

ventricular fibrillation may substantially overlap with those of sudden death. The only indication of electric injuries is a burn mark. Electric marks have an irregularly rounded shape. However, it is not uncommon to see other forms. Sometimes, they can be hidden by either fold of skin, hair, hand calluses, or by the same skin burns such as those caused by an arc or related to clothing fire. The injury due to electricity may include burns to the skin and deeper tissues, cardiac rhythm disturbances and other associated injuries due to falls and other trauma. The amperage, voltage, type of current, duration of contact, tissue resistance and current pathway through the body will determine the type and extent of injury. Higher voltage, greater current, longer contact and flow through the heart are associated with worse injury and worse outcome. The passage of substantial electrical current through the tissues can cause skin lesions, organ damage and death. This injury is commonly considered as electrocution injuries. As with many other injuries shape of the object causing electrocution may sometimes be noticed, constituting patterned electric mark. This finding may be helpful in reconstruction of the injury events and giving final opinion on cause of death in an electrocution death / in situation of obscure / negative autopsy cases. The wound may also be lacerated, and punctured with contusions at its margins. The point of exit of current or the 'earth' takes place through the bare sole of the foot. Sole of the foot may turn hard and thick and even be ruptured giving a deep laceration like appearance. Singeing of hair and burning of clothes may also be noticed at the location. Electron microscopy has recently visualized these metallisation as tiny globules of molten metal on the skin at and near electric marks. Macroscopic and microscopic analysis of the current mark using a variable-pressure scanning electron microscope equipped with energy dispersive X-ray micro analyzer to highlight skin metallisation, indicating the presence of iron and zinc. Micropathological skin changes at electrocution site may be seen in electrical burn. These local lesions are usually found in the hands or fingers at the points of entry and exit of electric current, which are more severe and are observed mostly over feet or opposite hands. The molten keratin over these area fuses into multiple hard brownish nodules on cooling and resembles skin of the crocodile. Finally, it may also be remembered here that non-electrical causes such as fall / being thrown from height resulting in head injuries, more often result in fatality in a victim of electrocution.[6-11]

Forensic Aspects

Death by electric current is usually accidental but cases of suicide and homicide have also been recorded. Bathroom is a common site for electrical tragedies. Accidents, suicides and even homicides occur there because of its vulnerability to electric shock. Often ejaculation of semen may take place at death. In cases of electrocution with wet body surface no positive findings may be present and autopsy in such cases may be an obscure one.

DISCUSSION

In electrocution for death to occur, the human body must become a part of an active electrical circuit having current capable of over stimulating the nervous system or causing damage to internal organs. The extent of injuries received depends on the magnitude of the current (measured in Amps), the pathway of the current, the duration of current flow and the resistance offered by the body. Whereas, in high voltage currents skin condition plays no significant role in resistance. Electric current takes the path of least resistance and creates heat, and causing thermal damage to various tissues along its passage. Most of the deaths from electricity are from cardiac arrhythmias, usually ventricular fibrillation leading to cardiac arrest. It is due to passage of current through the myocardium and possible dislocation of pace making nodes. Death may occur as a result of respiratory arrest, due to paralysis of inter costal muscles and diaphragm or rarely by affecting the brain stem, when the current enters through the head. But it must always be remembered that non-electrical trauma is quite common. With electric source of higher voltage, current might be transmitted by means of arcing, caused by formation of conductive plasma between the source and the ground. The blast effect of high-voltage arcing can throw the victim away from the source, causing fatal injuries. The sustained burn injuries were due to arcing of the current, giving rise to the appearance of 'crocodile skin'. The victim suffered non-electrical injuries from being thrown to the ground, both the entry and exit wounds were seen. This extremely high voltage current causes the epidermal keratin to melt and, after cooling, it leaves a raised brown or yellow nodule of fused keratin surrounded by an areola of pale skin. Electrocution is an uncommon cause of death and occurs commonly due to accident. Deaths due to electrical injuries are low when compared with deaths due to other causes. As the electric injuries involve multiple body systems, the

entry and exit wounds fails to reflect true extent of the underlying tissue damage. Injuries from high voltage electrocution pose a serious threat to life increasing the mortality rate. Most of the electrocution deaths are preventable in nature and they can be prevented by implementing proper educational programmes to the society including the electricity board workers with regard to the usage of safety appliances and insulators. Children should be taught about the dangers of electricity and importance of electric safety.

CONCLUSION

Most of the electrocution fatalities were caused by high-voltage electrical currents which were due to direct contact with a power line. The majority of the victims generally remains young males, who experienced their electrical injuries while on the job. Most all of the electrocution deaths are preventable, this study indicates a need for continuous vigilance on safety training. Diligent enforcement of existing safety regulations is necessary to increase workers' and non-workers' keen understanding of the lethal potential of electricity and adherence to these rules. Electric accidents cause serious injuries by direct heat exposure or by igniting clothes. The severity varies between simple harmless shocks to death. Many at times the victims are thrown to ground from the electric poles sustaining fatal non electric injuries. In this study a case of high voltage electrocution is reported and discussed. In this case the victim sustained injuries due to arcing of current, there were exit wound in the leg indicating direction in the toe of current. The victim suffered fatal head injuries due to fall.

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