

A Death in a Tea Estate as a Result of Illicit Power Trapping

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Abstract

Electrocution results when a human is exposed to a lethal amount of electrical energy. Electrocution is the cause of death for approximately 1000 people in the United States every year. In Sri Lanka common causes for injuries due to electrocution include use of defective electrical appliances, faulty wiring, failure to take safety precautions and installations of unauthorized connections from high tension lines. In this case the deceased was a 48 year-old farmer from a rural area in Galle district. On this particular day, the deceased left home around 9.00 p.m. to go to his paddy field and did not return. The next morning, he was found lying unresponsive on a tea estate near his paddy field. At the post-mortem examination, multiple 2nd degree burns were found on the front aspect of the right upper thigh, back of the middle third of the right forearm, front of the upper third of the left leg and between the base of right thumb and index finger. Ruptured blister was present on the back aspect of the thumb over the metacarpophalangeal joint. Musculo-skeletal dissection revealed charred subcutaneous tissues and superficial layers of the muscles underline the above-mentioned injuries. No deep contusions or fractures were seen. The cause of death was electrocution. This was an unfortunate case of accidental electrocution of a farmer due to application of an unauthorized power line to trap wild animals. The most likely mechanism of death was ventricular fibrillation. A detailed history regarding the incident, scene visit and proper postmortem examination with the histological and toxicological analysis are recommended prior to concluding the cause of death as electrocution.

Keywords: Electrocution, Ventricular fibrillation, burns

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Introduction

Electricity is an important energy source for our modern society. Electrical burns are responsible for considerable amount of morbidity and mortality. Electrocution results when a human is exposed to a lethal amount of electrical energy. Injuries from electricity have been reported for almost 300 years. The first documented death following electrocution dated back to 1879, where a carpenter in Lyons, France died following accidental electrocution.^[1] In the United States, there are approximately 1000 deaths per year, as a result of electrical injuries and out of these, approximately 400 are due to high-voltage electrical injuries.^[2] According to a study done in Australia, in 2014 to 2016 period, almost 1,100 hospitalized cases were identified as having an electrical injury and during the same period, there were 55 deaths due to electrocution.^[3] Low-voltage electrical fatalities are much more frequent than the high-voltage ones. Almost all fatalities by electrocution are accidental, while homicides and suicides are very rare or uncommon.^[4,5,6] According to literature, a distinguishable difference in the pattern of electrocution deaths exists between the

western world and the low income countries.^[7] Suicidal electrocutions are frequent in the western world and in comparison accidental deaths are more prevalent in the low income countries.^[8] In the high and middle income countries, electrocution is an uncommon phenomenon mainly due to the better safety precautions and increased awareness of the hazardous outcomes.^[7] Same cannot be said about the developing countries where the safety precautions are sometimes inadequate.

As explained by the Ohm's law, current is directly proportional to voltage and inversely proportional to resistance of the body. Therefore the severity of the injury mainly depends on the amount of current flow, voltage and resistance of the body.^[9] Other factors that influence the electric injury are type of current, current pathway and duration of contact with an electric source.^[10]

In Sri Lanka common causes for injuries due to electrocution include use of defective electrical appliances, faulty wiring, failure to take safety precautions and installations of unauthorized

connections from high tension lines. As the human population grows and agricultural areas expand at the expense of forests, wild animal habitat is being reduced continually. Conflicts between wild animals and humans are inevitable when both species live in the same ecological environment.[11] Wild animals mainly destroy crops, however may sometimes damage houses and kill people. Farmers in return shoot at them by using firearms and set traps using illicit power lines.[11] Injuries due to accidental contact with such power lines are becoming frequent day by day however, the actual statistics related to those cases are not available. Only the fatal and serious cases are being reported. In the case under discussion the deceased was a victim of fatal electrocution from unauthorized power supply which was drawn to trap animals.

Case report

The deceased was a 48-year-old farmer from a rural area of Galle district. He lived with his family one kilometer away from the Yakkalamulla junction. His paddy field was situated about half a kilometer away from his house and he walk that distance every day through a foot path going over a tea estate owned by neighbors. He also used to leave home at night to protect his paddy field from animals' like. Occasionally he spent the night in a small hut prepared by him at his paddy field.

On this particular day, the deceased left home around 9.00 p.m. to go to his paddy field. He did not return home at that night, but his wife was not worried about it because he used to spend nights at the paddy field. Next morning around 7.30 a.m. she was informed by the villagers that his husband was lying unresponsive on a tea estate near his paddy field.

The police visited the scene around 9.00 a.m. in the morning and they found the deceased lying on his back on a tea estate about three meters away from the foot path. Inquirer into Sudden Deaths of the area had visited the scene and advised the police to inform the judicial medical officer for a scene visit. The scene visit was done on the same day at 11.30 am. On one side there was a paddy field of several archers and on the other side was a small jungle from where the animals used to come. The area was covered with shrubs and bushes. Adjacent to the jungle there was a tea estate and the body was found to be lying under a bush about three feet away from the foot path. The ground was water lodged and slippery due to rain. No cables or wires were seen around. The grass on that area appeared flattened and disturbed over an area of 2 x 2 meters. There was no blood or any other stains at the scene. The body was that of a middle aged male, identified by the relations. The body was lying in supine position with both hands clenched tightly showing cadaveric spasm (Figure 01).



Figure 01 – Clenched both hands with cadaveric spasm

One hand was holding a torch and the other hand was holding grass. Rigor mortis was fully developed and no evidence of putrefaction was seen. Burn injuries were observed on right hand, right forearm, right thigh and right knee joint. A lamp post carrying a domestic power line situated in the tea estate about 7 meters away from the place where the victim's body lying. The body was transported to the mortuary and the autopsy was carried out with the direction of the Inquirer into Sudden Deaths.

The body was that of an averagely built, moderately nourished middle aged male. There were no discharges coming from mouth or nose. Body was clad in a blue colour sarong and an ash colour shirt. Both were mud stained. There was a linear deficiency with blackened and fragile margins, situated obliquely on the front of the sarong (Figure 02).



Figure 02 – Sarong with a linear deficiency

Approximately rectangular shaped 2nd degree burn was found on the front aspect of the right upper thigh with singeing of hair. There were areas of peeling off of epidermis adjacent to the burnt area. (Figure 03).



Figure 03 – second degree burn on the right upper thigh

An elongated crater with a patterned burnt and blackened base and elevated margins, was found on the back of the middle third of the right forearm. There were two areas of peeling off of epidermis, exposing the reddened dermis, situated on either side of crater. (Figure 04)



Figure 04 – elongated crater with peeling off of skin on right forearm

An elongated crater with a patterned burnt and blackened base and elevated margins, was seen on the front of the upper third of the left leg. (Figure 05)



Figure 05 – elongated crater on right lower leg

Roughly spindle shaped crater was found between the base of right thumb and index finger. The base of the crater was pale with elevated margins together with surrounding puckering. Ruptured blister was present on the back aspect of the thumb over the metacarpo-phalangeal joint. (Figure 06)



Figure 06 – right hand with joule burn

Head was free of any external or internal injuries. There were no underline skull fractures. Meninges appeared normal. Superficial blood vessels and blood vessels of the base of the skull were congested. There was no intracranial haemorrhages. The neck was devoid of injuries. Lungs appeared unremarkable. The weights of the left and right lungs were 350g and 375g respectively. The heart weighed 325g. All 4 chambers and valves were devoid of any pathology. Coronaries were patent. The stomach contained partially digested food. There was no smelling of alcohol. No pathology was found in other abdominal organs. Musculo-skeletal dissection revealed charred subcutaneous tissues and superficial layers of the muscles underline the

above mentioned injuries, however, no deep contusions or fractures were seen.

Histopathology of all organs were performed. Other than a mild congestion of the brain and lung tissues, all other organs were free of any significant pathology. Histopathology examination of the tissues taken from burn sites revealed marked charring involving epidermis, dermis and subcutaneous tissue with the involvement of the superficial part of the muscle. Intra-epidermal blisters and palisading of the basal cells were also seen. Toxicology analysis did not reveal alcohol or common poisons.

After considering the evidence from history, scene visit and circumstantial evidence, autopsy examination and investigations, the course of death was given as electrocution.

Discussion

During the last century, usage of electricity has increased dramatically all over the world. However, during the same period of time, the incidence of electrical fatalities has not risen as much as expected.^[12,13] This could be due to the improvements in workplace safety measures and the quality and safety of electrical installations reducing the risk of injuries and deaths. Still, fatal injuries caused by electricity do occur and can present a challenge for the forensic pathologist performing the autopsy.

Electrocution may occur when someone is exposed to a lethal amount of electric energy, mainly due to carelessness, misuse, or improper maintenance of equipment or wiring. According to the National Safety Council of the United States, electrocution was the fourth leading cause of work-related traumatic death.^[2] 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.^[5] Low-voltage currents and high-voltage currents are equally able to cause electrocution-related fatality. Most of the electrocution fatalities are caused by high-voltage electrical currents which is due to direct contact with a power line. Even though the low voltage electrocutions are more frequent, fatalities related to this is un common.

“Sri Lanka being a predominantly agricultural country, farming contributes to 20% of its Gross National Product (GNP), with about 75% of the country’s labour force dependent on agriculture for its livelihood”.^[11] Many farmers found it very difficult to protect their crops from the wild animals. Help they received in this regard from the department of wildlife conservations is very limited. Therefore, the farmers resort to illegal methods such

as shooting, poisoning or using electric traps to protect their harvest. Unfortunately, the methods used for the protection of their own crop sometimes can back fire, as in this case, and can ended up killing the man instead of the wild animal.^[11]

The distinct injury marks formed at the place of contact with electric current (entry mark) and joule burns can be considered as a classical external sign of electrocution. Injuries present over the right thigh, left leg and right forearm were similar in nature. They were elongated craters with a patterned burnt and blackened base and elevated margins, with one was situated on the upper third of the front of the right thigh, the second one was situated obliquely on the antero-lateral aspect of the middle and the lower third of the left forearm arm and the third one situated obliquely on the front of the left leg extending medially up to the knee joint. Injury present on the right palm was a joule burn. These were the points at which the electric current entered the body, and the mark produced, was an electrical burn.

The production of electrical burns depends on voltage, amount of current flow and the duration of contact.^[9] An electrical burn occurs only if the temperature of the skin is raised enough for a sufficiently long period to produce damage.^[9] An electrical burn, as in this case may have a characteristic crater like appearance with central charring, or may resemble an abrasion or second – degree or third-degree burn.^[14] The charring was most probably due to prolonged contact with the conductor. The elongated appearance is due to it taking the shape of the wire. The diameter of 0.4 cm is probably the diameter of the wire. This is conclusive evidence that the deceased was in contact with the live wire and most probably would have accidentally fallen on to it. The reason for the ‘crater’ is due to collapse of the blister that would have formed due to the vaporization of the tissue fluids.^[14,15] The blister collapses during the cooling process. This is because the volume decreases as condensation of steam occurs. Since this is inside a closed cavity, the blister collapses. The margins remain elevated, as there is separation of the epidermis from the dermis. The pallor in the margin is most likely due to arteriolar spasm from the direct effects of the current on vessel wall musculature, and is virtually pathognomonic of electrical damage.^[15]

Histology sections of electric marks showed marked charring of epidermis, dermis, subcutaneous involving the muscles which indicated a prolong contact. Vacuolation of epidermis and splitting of epidermo-dermal junction is caused by the gas produced from the heated tissues splitting the cells apart. [14] Palisading appearance could be seen in

basal layers of epidermis. This is also referred to as streaming of the nuclei by the American authors.^[9] This effect is not path gnomic of electrical burns, but is seen in any thermal buns.

In deaths from electrocution the lethal event may be directly due to the electrical energy itself, or to the secondary effects of burns or blunt injuries due to falls precipitated by the electric shock [9]. The immediate mechanism of death due to the passage of current through the body usually includes ventricular fibrillation, respiratory center paralysis and respiratory paralysis.^[16] Contact with electrical current may cause an individual to be thrown back with considerable force resulting in potentially lethal traumatic injuries.^[16] Cases have been reported where individuals in swimming pools have drowned following electrical shocks.^[16]

Ventricular fibrillation is considered to be the commonest cause of death and follows the passage of electrical current through the heart. The precise effect of electrical current on the myocardium is ill understood; however, it is most likely involving a direct action on cardiac myocytes, nodal tissue and conduction tracts.^[9] Respiratory Paralysis is much less common than cardiac arrhythmias and involves passage of current through the chest with respiratory paralysis due to severe contraction of respiratory muscles, such as the diaphragm and intercostal muscles, with resultant asphyxia and cardiac arrest.^[16] It is more often seen in high voltage deaths. Paralysis of the Respiratory Centre may rarely occur if current passes through the respiratory center in the brainstem causing disruption of neural function due to the direct effect of electrical current or secondarily to hyperthermia.^[16]

In this case the victim had electric current entry wounds on his right thigh, left lower leg, right forearm and right hand. Lack of exit wound could be due to the wet nature of the ground. He did not have any signs of asphyxia such as congestion cyanoses, petechial haemorrhages, and oedema suggestive of respiratory paralysis. Therefore, the mechanism of death in this case is most likely to be ventricular fibrillation due to the passage of current across the heart.

All deaths caused by electricity are reportable to the Inquirer into Sudden Deaths. Inquest procedure and the instructions to the inquest are laid down in the sections 369 – 373 of the Criminal Procedure Code of Sri Lanka. Section 370 (1) provides the legal framework to hold inquiries into unnatural deaths and the deaths due to electrocution is a form of unnatural death.

Although the manner of death in this case was accidental it had been caused by contact with an

unauthorized electric line illicitly drawn from the main supply line.

According to section 67 of Electricity Act of Sri Lanka, whoever, (a) not being authorized officer of a licensee or the board, connects or disconnects any electric line through which energy is or may supplied by the licenses or from any meter, indicator or apparatus, (b) Without the consent a license or the board lays or causes to be laid any electric line or connects up any electric line, equipment, apparatus or works, forth purpose of establishing a connection with any electric line apparatus or works belonging to a licensee or the board, shall be guilty of an offence punishable with a fine not exceeding five hundred rupees, and in the case of a continuing offence, with a daily fine not exceeding twenty-five rupees.^[17]

Hence the man involved for this unauthorized connection can be charged under the electricity act of Sri Lanka. Furthermore, this person can be charged for culpable homicide not amounting to murder since the act is rash and negligent and end up killing an innocent man.

Conclusions

Even though the deaths following low voltage electrocutions are rare, from time to time new cases immerge. This was an unfortunate case of accidental electrocution of a farmer due to application of an unauthorized power line to trap wild animals. The presence of water on the ground and the absence of insulating footwear could have been contributory factors. The mechanism of death most likely was ventricular fibrillation. Gross findings of postmortem examination and features in microscopic examination are in favour of electrocution as the cause of death.

A detailed history regarding the incident, scene visit and proper postmortem examination with the histological and toxicological analysis are recommended prior to concluding the cause of death as electrocution.

Disclosure statement

Conflicts of interests: The authors declare that they have no conflicts of interests.

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