



## Case Series- High Voltage Electrocution

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### Abstract

Deaths due to electricity are quite uncommon and generally categorised as accidental, usually related to occupation, as suicide or homicide cases are rare. High voltage electrocution cases are comparatively less but show a high rate of mortality. This case series discusses about different high voltage electrocution cases in different circumstances. Autopsy revealed typical electric injuries with first- and second-degree burns, spark burn, flash burn and peeling of epidermis at different sites on body.

**Keywords:** Accidental electrocution, Electrical injuries, High voltage electrocution

### Introduction

Electrocution injury is due to flowing of the substantial electric current through the body by means of lightning, low voltage or high voltage current and commonly associated with high mortality and severe systemic complications resulting in the dysfunction of multiple tissues or organs<sup>1</sup>. Most cases of high voltage electrocution are accidental, involving young males and particularly electrical workers<sup>2</sup>.

A voltage greater than 1000 volts is considered as high voltage current and injury caused by it leads to very high rate of morbidity as well as mortality by mechanism of ventricular fibrillations, respiratory paralysis and trauma after flinging<sup>3</sup>. Electrocution injuries depends on many factors like voltage, frequency of current, duration of contact with body, route of current in body and atmospheric conditions. Fatal electric injuries may take place in several ways like direct contact with electricity, electrical arcs, or flame burns. Main reason behind maximum cases of electrical fatalities in accidental electrocution is

carelessness or ignorance which can be prevented by simple safety measures in most of the situations<sup>4</sup>.

This case series discusses the injuries caused by high voltage current under different circumstances and highlights the gross findings of electrocution and correlation of such injuries with scene of death.

### Case Report 1

A dead body of a 24 years old male, electrician by profession, averagely build, was brought for the post mortem examination to the mortuary of PBM Hospital. According to investigating police officer the alleged incident happened while victim climbed on light pole and accidentally slipped over high-tension line which passing besides him. The alleged victim suffered high voltage shock and was declared dead at the scene of incident.

Post mortem staining could not be detected due to burn lesion, rigor mortis present on all over body. Both eyes and mouth were closed and body soiled with mud. All other natural orifices were in normal

state. Body present in pugilistic attitude, both hands stained with silver paint.

Following antemortem injuries were present on deceased body at the time of post mortem examination. Multiple electric burn lesion of varying size from (6.4×3.4) cm to (0.8×0.8) cm present on back of trunk at places with pale hard base and ashy grey in colour with crater formation (Fig.1). Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening and singeing of hair on head, face, neck, trunk, both upper & lower limb and genitalia except both palmer and sole region at places (Fig.2). Multiple heat ruptures of size varying from (1.5×1.8) cm to (10×1.4) cm present on left lower limb at places with pale base. Two heat ruptures of size (14×2) cm and (6×1.6) cm with pale base present on right leg at upper third area posteriorly. Burn area covered about 85% of total body surface area and duration of injury was fresh prior to death.

All the visceral organs were congested and brain was congested and oedematous.

The cause of death was antemortem electrocution.

### Case Report 2

A dead body of a 47 years old male, driver by profession, averagely build, was brought for the post mortem examination to the mortuary of PBM Hospital. According to the investigating police officer the alleged incident happened while the victim was reversing back his truck which got in contact with high-tension wire overhead. The alleged victim suffered high voltage shock and was declared dead at scene of incident.

Post-mortem staining present on back, except pressure area and not fixed. Rigor mortis present on both eye lids, jaw muscles, neck and weakly upper and lower limbs. Both eyes and mouth were closed. Blood mixed fluid coming out from both nostrils and body was soiled with mud.

Following antemortem injuries were present on deceased body at time of post mortem examination. Antemortem electric burn lesion present on forehead, left side just above the eye brow with size of (5.2 ×3.4) cm with pale & hard base with blackening of margins and base at places, erythematous surrounding and crater formation present (Fig.3). An

electric burn lesion of size (8.8 ×5.6) cm which is bone deep with dry hard base, everted margin, crater formation, reddish pink muscle fibres are seen on base at places and soiled with sand particles at places. Electric burn lesion of size varying from (1.8 × 1.2) cm to 0.5 × 0.5 cm present on tip of all fingers of right-hand palmer aspect with pale, hard base and ashy grey in colour and crater formation. Multiple burn lesion of size varying from (6.6× 4.4) cm to (0.5× 0.5) cm present on left foot ventral aspect on heel and all tip of toes respectively with pale hard base and ashy grey in colour and crater formation. Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening & singeing of hair at places on right arm & forearm (Fig.4). Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening & singeing of hair at places on left leg and foot. Multiple superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening & singeing of hair at places on chest anteriorly and posteriorly. Electric burn lesion of size (3.8 × 2.8) cm present on right iliac region laterally with pale hard base with blackening margins and crater formation present. Burn area cover about 20 % of total body surface area and duration of injury fresh prior to death.

All the visceral organs were congested and brain was congested and oedematous.

The cause of death was antemortem electrocution.

### Case Report 3

A dead body of a 61 years old male, labour by profession, averagely build, was brought for post mortem examination to the mortuary of PBM Hospital. According to investigating police officer the alleged incident happened when he was setting tent in a marriage party and accidentally, he touched uninsulated electric wire placed on ground. The alleged victim suffered high voltage current and declared dead at scene of incident.

Rigor mortis present on both eye lids, jaw muscles, neck, chest and weakly upper & lower limb. Post mortem staining present on back except pressure area, fixed. Both eyes open & mouth slightly open and all other natural orifices were in normal state.

Following antemortem injuries were present on deceased body at time of post mortem examination. Ante mortem electric burn lesion of size 3.2 ×2.8 cm

present on 1st web space of right hand, 1.2 ×1 cm present on right thigh upper 3<sup>rd</sup> medially and 4.2 × 3.2 cm present on left thigh upper 3<sup>rd</sup> medially with pale hard base, ashy grey in colour with crater formation and peeling of skin with margins blackening at places and surrounding erythematous appearance.

All the visceral organs were congested and brain was congested and oedematous.

The cause of death was antemortem electrocution.

#### Case report 4

A dead body of a 43 years old male, electrician by profession, averagely build was brought for post mortem examination to the mortuary of PBM Hospital. According to investigating police officer the alleged incident happened when he climbed on electric pole and accidentally touched high tension wire and after that fell from pole. The alleged victim suffered high voltage current and declared dead at scene of incident.

Rigor mortis developed all over body ,Post mortem staining could not detected due to burn lesion.

Following antemortem injuries were present on deceased body at time of post mortem examination. Antemortem electric burn lesion present on occipital region, left lateral side of neck with size of (19 ×8.4×2) cm with charring of soft tissues near margins and base with peeling of skin surrounding, multiple electric burn lesion of size varying from (4.8 ×2.6) cm to (3 x 2) cm present on right forearm and hand at places with pale, dry hard base, ashy grey in colour, everted margin with crater formation. Electric burn lesion of size varying from (15.8 × 8.2) cm to (3.5 × 1.5) cm present on both lower limb at places with pale, hard base and ashy grey in colour and crater formation with charring of soft tissues near margins with peeling of skin surroundings with fracture of right femur bone, tibia and fibula bones. There was superficial to deep dry heat flame burn with peeling of skin red line of demarcation, blackening and singeing of hair at places present on whole back. Burn area cover about 60 % of total body surface area and duration of injury fresh prior to death.

All the visceral organs were congested and brain was congested and oedematous.

The cause of death was antemortem electrocution.

#### Case Report 5

A dead body of a 11 years old child, averagely build, was brought for the post mortem examination to the mortuary of PBM Hospital. According to investigating police officer the alleged incident happened while victim went to his farm and accidentally high-tension wire fell on him which was passing over him. The alleged victim suffered high voltage shock and was declared dead at the scene of incident.

Post mortem staining could not detected due to burn lesion & Rigor mortis developed all over body ,both eyes and mouth slightly open , pupils bilateral dilated & fixed .

Following antemortem injuries were present on deceased body at the time of post mortem examination. Two electric burn lesion of size (4.4×3.4) cm present on left hand palmer aspect and (7.8 x 6.7) cm present on left thigh lower third anteromedially with pale hard base and ashy grey in colour with crater formation. Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening and singeing of hair on head, face, neck, trunk, both upper & lower limb and genitalia except right palmer and both soles. Burn area covered about 85% of total body surface area and duration of injury was fresh prior to death.

All the visceral organs were congested and brain was congested and oedematous.

The cause of death was antemortem electrocution.

#### Case Report 6

A dead body of a 36 years old male, averagely build was brought for the post mortem examination to the mortuary of PBM Hospital. According to investigating police officer the alleged incident happened while victim went to fair and accidently walked on high tension wire placed on ground and then fell down. The alleged victim suffered high voltage shock and was declared dead at the scene of incident.

Post mortem staining could not detected due to burn lesion & Rigor mortis developed all over body and Both eyes and mouth closed and pupils dilated & fixed.

Following antemortem injuries were present on deceased body at the time of post mortem

examination. Two electric burn lesions of (1.4×1.2) cm and (0.8 x 0.8) cm present on great toe and second toe of right foot plantar aspect with pale hard base and ashy grey in colour with crater formation. Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening and singeing of hair on head, face, neck, trunk posteriorly and left side anteriorly, both left upper & lower limbs and right foot and thigh at places and burn area covered about 60% of total body surface area and duration of injury was fresh prior to death.

All the visceral organs were congested and brain was congested and oedematous.

The cause of death was antemortem electrocution.

### Case Report 7

A dead body of a 27 years old male, working in electric power plant, averagely build was brought for the post mortem examination to the mortuary of PBM Hospital. According to investigating police officer alleged incident happened while victim unloading the truck containing poles at electric power plant and accidentally touched the high-tension wire passing over him. The alleged victim suffered high voltage shock and was declared dead at the scene of incident.

Post mortem staining present on back and dependent parts of body except pressure area and fixed. Both eyes not closed completely and mouth was open exposing anterior teeth. All other natural orifices were normal in state. Whole body soiled with sand particles at places.

Following antemortem injuries were present on deceased body at time of post mortem examination. Antemortem two electric burn lesions of size (2.5 x 1.4) cm present on great toe of left foot and (8.4 x 6.4) cm present on heel of left foot with dry, pale hard base, everted margins, ashy grey in colour and crater formation. Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening & singeing of hair at places present on left arm laterally, right side back of chest, right shoulder laterally, right arm and both legs. Burn area cover about 16 % of total body surface area and duration of injury fresh prior to death.

All visceral organs were congested, brain was congested and oedematous.

The cause of death is antemortem electrocution.

### Case Report 8

A dead body of a 25 years old male was brought for the post mortem examination to the mortuary of PBM Hospital.

The subject was averagely build & nourished. Post-mortem staining present on back, except pressure area and fixed. Rigor mortis present on all over body except eye lids. Both eyes and mouth were slightly opened. Whole body was soiled with sand particles.

Following antemortem injuries were present on deceased body at time of post mortem examination. Antemortem two electric burn lesion of size (2.5 x 1.4)cm present on great toe of left foot and (8.4 x 6.4)cm present on heel of left foot with dry, pale hard base, everted margins, ashy grey in colour and crater formation. Superficial to deep dry heat flame burn with peeling of skin, red line demarcation, blackening & singeing of hair at places present on left arm laterally, right side back of chest, right shoulder laterally, right arm and both legs. Burn area cover about 16 % of total body surface area and duration of injury fresh prior to death.

All visceral organs were congested, brain was congested and oedematous.

The cause of death is antemortem electrocution.

### Case report 9

A dead body of 34 year old male was brought to mortuary of PBM Hospital for post mortem examination. According to the history given by police person and relatives, victim was working as confectioner in a marriage event. While using mixer juicer with wet hands he got electrocuted.

The Subject is averagely built and well nourished. Post mortem staining present on back in patchy manner except pressure areas and not fixed. Rigor mortis present in both eyelids, jaw muscles and weakly in neck muscles. Both eyes and mouth closed. Bluish discolouration of finger tips and nails. All other natural orifices in normal state.

Reddish black discolouration present on palmer aspect of both hands, on touch felt hard at places, there are multiple tiny crater present at places, On dissection, pale hard base with ashy discolouration present

All visceral organs were congested, brain was congested and oedematous.

The cause of death is antemortem electrocution.

### Case report 10

A dead body of 20 year old male was brought to mortuary of PBM Hospital, Bikaner for post mortem examination by police person. The victim was a cattle herder, while walking in his fields on a rainy day he accidentally came in contact with wires of a pole and got electrocuted.

The subject was averagly build and nourised .post mortem staining present on back except pressure areas and fixed. Rigor mortis present all over body. Eyes and mouth open. Pupils dilated and fixed. All other natural orifices in normal state. Body soiled with mud and leaves. Three antemortem electric burn lesions of size (13.5 x 6.8)cm on right forearm upper half posteriorly, (7.5 x 6.5)cm on right knee and (5.4 x 4.8)cm on abdomen right side middle third laterally with pale, hard base, ashy grey in colour with crater formation with charring of soft tissue near margins and base with peeling and blackening of skin surroundings.

All visceral organs were congested, brain was congested and oedematous.

The cause of death is antemortem electrocution.

### Case report 11

A 28 year old female was brought dead in medicine casualty of PBM Hospital by her uncle with history of sudden collapse. During post mortem, electric burn lesion was present on neck right lateral side. During investigation, IO cited it as a case of homicide. The deceased was known case of psychiatric disorder and her impulsive behaviour provoked family to injure her with open electric wire. The Subject was averagly built and nourished. post mortem staining present on back except pressure areas and fixed. Rigor mortis passed off, weakly present on lower limbs. Body under the stage of putrefaction, post mortem purge present on nostrils, marbling present on face, neck, chest and both shoulders. Greenish discoloration present on right iliac region.

All visceral organs were congested, brain was congested and oedematous.

An antemortem electric burn lesion of size 1.6 cm x 1 cm present on neck right side lower third anterolaterally with elevated margins, hard pale base, ashy grey in colour and crater formation.

### Discussion

An electrical burn occurs when the temperature of skin raised enough for a sufficiently long time to cause damage. Low or medium voltage current cause electric marks and joule burn while an arc produces considerably more burn than a contact which continuously transmits the current<sup>5</sup>. Although incidence of high voltage electrocution is low in comparison with other types of electrical injuries but fatality rate is very high with direct contact or indirect arcing or flashover effect.

In human body depending on the water content and electrolytes presence, resistance varies between tissues. Therefore, lowest resistance found in blood vessels, neurons and muscles while bone, fat and skin show high resistance. Skin resistance also increases with thickness, dryness and keratinization contrastingly moist mucous membranes or punctures, lacerations etc. in skin decrease the resistance. Tissue with greater resistance tends to suffer more damage as a result of an electric current<sup>6</sup>.

Therefore, examination during autopsy reveals electric burn marks preferably on the skin not on soft organs. Thick epidermal areas i.e. on palm, sole and back which offers substantial resistance than areas which have thin epidermis. After electrocution, no resistance offered by charred skin which significantly reduce the shielding property of skin.

Electric marks, joule burns and also both entry and exit marks are generally found only in cases of low or medium voltage current injuries so, sometimes in absence of proper history and circumstantial evidence it is difficult to diagnose high voltage electrocution.

In high voltage electrocution there is a type of electric burn known as spark burn which occurs when there is no actual contact but electricity sparks to the skin through a narrow zone of air. Very high temperature leads to melt the keratin over a small area which takes the shape of hard brownish nodule, generally raised above the surrounding skin and known as spark lesion. Area surrounding the spark lesion is blanched or pale<sup>7</sup>.

There is another added type of burn in high voltage electrocution i.e. flash burn which takes place due to arcing of current from high tension wires. It can cause all types of burn but typical lesion is crocodile lesion<sup>8</sup>.

Low voltage current associated with an immediate uncomfortable sensation that will not result in any significant injury. While high voltage current tends to result in either electrochemical or thermal damage to affected tissues with the risk of causing protein coagulation, haemolysis, thrombosis or dehydration. Tissue fluid evaporation caused by heat results in separation of epidermal cells<sup>1</sup>.

The present case series refer to different cases of high voltage electrocution and behaved differently, under different circumstances. Gross consequences of tissues after high voltage electrocution and discusses about the injury pattern. According to the circumstantial evidence.

## CONCLUSION

Electric current can cause various effects when passes through human body ranging from localized muscular spasm to instantaneous death. Incidences of electrocution are mostly accidental and some time homicidal or due to lack of safety measures and negligent of employees behaviour at work places. So, deaths due to electric shock should be properly investigated for adopting future safety measures as well as there might be condition that compensation should be paid to victim. Educating the community and adoption of safety measures can prevent the

incidents of electric shock and reduce the mortality from fatal electrocution.

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**Figure 1- Multiple electric burn showing crocodile lesion**



**Figure 2- Superficial to deep dry heat flame burn with heat rupture**



**Figure 3- Electric burn**



**Figure 4-Superficial to deep dry heat flame burn**



**Figure 5-Electric burn lesion with crater formation**

