

Atypical Flash Burns following Low Voltage Electrical Explosion: The Importance of Forensic Engineering

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ABSTRACT

Background: Accidental electrocutions during working activities account for a considerable amount of morbidity and mortality.

Case Report: In this case, the findings were suggestive of a high voltage electrocution but the opinion of the electrical engineer helped the forensic pathologists to ascertain the real mechanism. A labourer was cleaning an abandoned porcelain factory, wearing incomplete protective attires, had a sudden explosion when he attempted to remove an iron pole with a shovel. He was thrown off and lost consciousness.

There were dark brown superficial burns on facing and exposed sides. Areas covered by the helmet, hair and beard were spared. There were burn-free radially arranged elongated areas of the skin around eyes and nose. Eye brows were partially singed and eye lashes were completely burnt. Inner aspects of both forearms (right more than left) were burnt leaving a horizontal upper margin at the elbow. The right sleeve of the shirt was melted along the fold with blister formation on the skin. Superficial light brown burns were on dorsum of both feet sparing the areas covered by the straps of slippers.

There were no charring, joule burns or multiple circumscribed and cavitated lesions. Though it was severe explosion involving more energy, the electrical engineer confirmed that it was a low voltage electrical explosion.

Conclusion: Severe flash burns including partial loss of eye brows, complete loss of eye lashes and melting of clothes suggested high voltage electrocution. The electrical expert confirmed a low voltage electrocution and the severity of the explosion could have been due to three phase supply and the close proximity to the transformer.

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► *Implication for health policy/practice/research/medical education:* Atypical Flash Burns following Low Voltage Electrical Explosion

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1. Introduction:

Forensic electrical engineering is a branch of forensic engineering. It is concerned with investigating electrical failures and accidents in a legal context (1).

In this case, the findings were suggestive of a high voltage electrocution but the opinion of the electrical engineer helped the forensic pathologists to ascertain the real mechanism.

2. Case Report:

A labourer was cleaning an abandoned porcelain factory, wearing incomplete protective attires, had a sudden explosion when he attempted to remove an iron pole with a shovel. He was thrown off and lost consciousness.

There were dark brown superficial burns on facing and exposed sides. Areas covered by the helmet, hair and beard were spared. There were burn-free radially arranged elongated areas of the skin around eyes and nose. Eye brows were partially singed and eye lashes were completely burnt (figure 1). He had pain in eyes, iritis and photophobia.

Inner aspects of both forearms (right more than left) were burnt leaving a horizontal upper margin at the elbow (figure 2). The right sleeve of the shirt was melted along the fold with blister formation on the skin. Superficial light brown burns were on dorsum of both feet sparing the areas covered by the straps of slippers (figure 3). There were no joule burns or multiple circumscribed and cavitated lesions.

Scene visit revealed a burnt electric appliance fixed to a wall (figure 4). Though it was a severe explosion involving more energy, the local electrical engineer of Electricity Board confirmed that it was a low voltage electrical explosion.

3. Discussion:

Accidental electrocutions during working activities account for a considerable amount of morbidity and mortality.



Fig. 1. Burn-free radially arranged elongated areas around eyes and nose. Partially burnt eye brows and completely burnt eye lashes. Hair and beard were shaved at the ward and were spared of burns.



Fig. 2. Note the burns on inner aspect of right forearm than left and the horizontal upper margins. Only the exposed and facing areas were burnt.



Fig. 3. Very superficial light brown burns on dorsum of both feet sparing the areas covered by the straps of rubber slippers.



Fig. 4. The electric appliance fixed to the wall was severely burnt and exploded.

In low voltage electrocution, joule burn is a classical finding at the entry wound. Usually it is a ruptured collapsed blister with charring at the centre, surrounded by a pale areola and a hyperemic border (2). Such burns were not found in this case.

There was no evidence of arcing such as multiple, circumscribed, cavitated lesions. The “crocodile skin” appearance² which were found in high voltage electrocution was also absent.

Flame burns are not limited to the exposed and facing sides and cause charring (3) which were not found in this case.

Radiant heat flash burns are uniform, superficial burns found only on the facing and exposed skin (3).

Areas covered with clothes, head hair, beard, helmet, slippers were spared. The sleeves of the shirt had prevented the underlying skin being burnt and the

exposed forearms showed burns with horizontal upper margin at elbows.

The absence of strap marks of the helmet on the sides of the face confirmed that he was not wearing the straps at the time of the incident.

The radially arranged elongated spared areas of the skin around eyes were due to sudden tight closure of eyes.

When he was handling the shovel, the inner aspects of the forearms facing towards the explosion were burnt.

The presence of diffuse, brown colored superficial burns only on facing sides of exposed skin confirmed that the injuries were that of flash burns due to radiant heat of an explosion.

Blisters and the severe burns on the right forearm could have been due to closer proximity of the blast when handling the shovel by this right handed person.

His face, at about twice the distance from the source of heat, would by virtue of the inverse square law, have received about 25% of the heat received by hands (4). Therefore, the thermal injury to his right hand was highest, to face was less and to the feet were least.

Radiant heat flash burns of low voltage electrocution usually cause only erythema of the skin without singeing of hair (5). Pain in his eyes and photophobia with iritis confirmed the presence of ‘Flash eye’ (4). In flash burns, the eye lashes are singed due to their erected posture (5).

High-tension electrocution shows the presence of severe flash burns, multiple, confluent areas of third-degree burns and, more significantly, multiple circumscribed and cavitated lesions associated with arcing (6).

Being thrown off and lost consciousness and the presence of severe flash burns including eye brows, complete loss of eye lashes and melting of clothes suggested that those could have been due to high voltage electrocution.

In low voltage electrocutions, the equipment that may have been involved should be photographed, x-rayed and examined electrically (7).

The electrical expert who investigated the crime scene confirmed that it was a low voltage electric supply and a defect in the electrical apparatus. The high severity of the electrical explosion was related to the three phase supply and its close proximity to the transformer.

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