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Determination of skin in electrocution deaths

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Abstract
Background: Electrocution is the main cause of death in developing countries. The present study was conducted to determine skin in electrocution deaths.
Materials & Methods: The present study was conducted on 75 electrocution deaths of both genders. The skin samples were examined for gross changes, processed in the routine manner and stained with Haematoxylin and Eosin. The slides were examined to see the histopathological changes.
Results: Out of 75 patients, males were 45 and females were 30. Upper extremity was involved in 47 cases, lower extremity in 20 and both in 8 cases. The difference was significant ($P < 0.05$). Denudation of epidermis with central depression was seen in 55, zone of redness in 16 and no abnormality in 4 cases.
Conclusion: Authors found that maximum deaths were seen in males and denudation of epidermis with central depression was most common finding of skin.

Keywords: Epidermis, Electrocution, Skin

Introduction
In the modern world electricity plays a crucial role in all our day to day activities. Electricity is omnipresent for Domestic and industrial work. Low and high Voltage can cause death due to electrocution. High voltage electrocution deaths are mainly occupational electrocution deaths. Low voltage current supplied to minor industries and domestic use can be responsible for maximum cases of electrocution [1].
Electricity is an important energy source for our modern society to which many workers and household occupants are exposed to during their daily life activities [2]. Electrocution is the cause of death for approximately 400 people in the United States every year. While the majority of electrocution fatalities are accidents, there are occasional suicides, and very rarely, homicides. The severity of electrical injuries is dependent upon several factors including voltage, type and amount of current flow, intensity of the electrical current, electrical source, and length of exposure to that source. Electrocution is a relatively uncommon cause of death for both domestic and work-related accidents as well as those in other contexts. 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 [3].
Deaths due to electrical energy is a "functional" death-type in most cases, because fatalities may happen as a result of cardiac arrhythmia/ventricular fibrillation, asphyxia, or electrically induced respiratory muscle contractions [4]. The present study was conducted to determine skin in electrocution deaths.

Materials & Methods
The present study was conducted in the department of Forensic Medicine. It comprised of 75 electrocution deaths of both genders. Ethical clearance was taken prior to the study.
General information such as name, age, gender etc. was recorded. The skin samples were examined for gross changes, processed in the routine manner and stained with Haematoxylin and Eosin. The slides were examined to see the histopathological changes. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

Results

Table I: Distribution of patients

Total- 75		
Gender	**Males**	**Females**
Number	45	30

Table I, graph I shows that out of 75 patients, males were 45 and females were 30.

Table II: Chief area of wounding

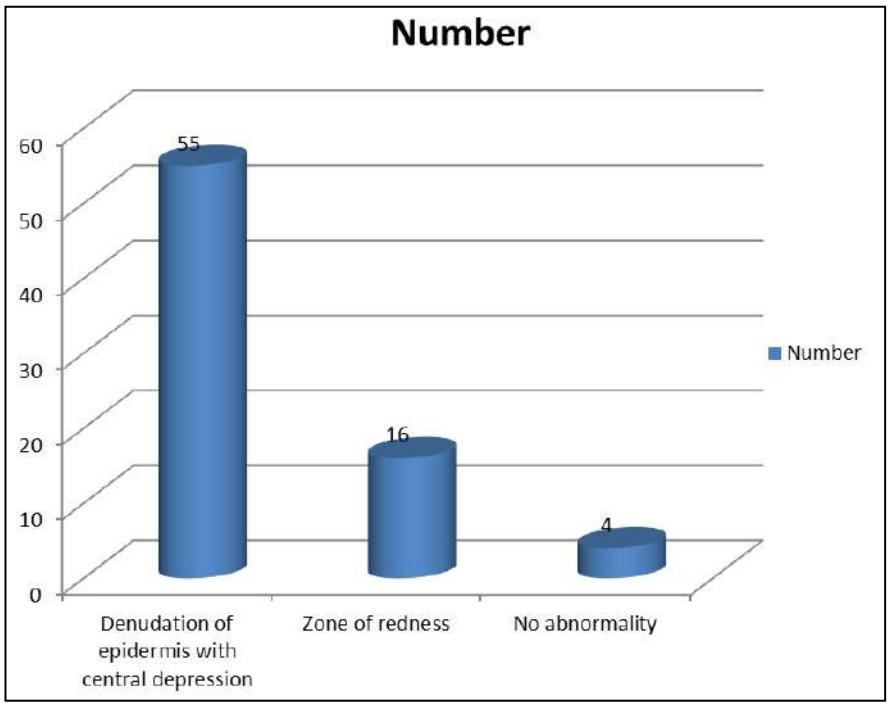
Area	Number	P value
Upper extremity	47	0.01
Lower extremity	20	
Both	8	

Table II shows that upper extremity was involved in 47 cases, lower extremity in 20 and both in 8 cases. The difference was significant ($P < 0.05$).

Table III: Gross appearance of the skin

Gross appearance	Number	P value
Denudation of epidermis with central depression	55	0.02
Zone of redness	16	
No abnormality	4	

Table III, graph I shows that denudation of epidermis with central depression was seen in 55, zone of redness in 16 and no abnormality in 4 cases. The difference was significant ($P < 0.05$).



Graph I: Gross appearance of the skin

Discussion

Forensic pathology is a subspecialty of pathology that focuses on determining the cause of death by examining a corpse [5]. Diagnosing ED is one of the most crucial role of the forensic science. 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 [6]. They are mainly preventable with simple safety measures in most situations. Almost two-thirds of work-related electrocutions in the U.S involves 600 volts or more. Studies have shown the highest proportion of electrocution deaths are occupation related accidents, accounting for up to 3% of all deaths in the population in 2014 [7].

The only indication of electric injuries is a burn mark. It presents in all cases of high-voltage electrocution whereas only 50% of low-voltage electrical deaths have 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 folds of skin, hair, hand calluses, or by the same skin burns such as those caused by an arc or related to clothing fire [8]. The present study was conducted to determine skin in electrocution deaths.

In present study, out of 75 patients, males were 45 and females were 30. Ashok *et al.* [9] studied skin samples from 29 cases of electrocution deaths. All 29 were accidental deaths. There were 76% males. Upper extremity was the chief area of wounding. The skin samples received showed denudation in 76% cases. The most common histopathological findings were nuclear streaming (96%), dermoepidermal separation (96%) and coagulative necrosis (89%). Electrocution deaths is one of the important cause of negative autopsy. The histopathological examination of the skin coupled with the circumstantial evidence, proper and complete inspection of the crime site can be very helpful to the forensic surgeon in arriving at the diagnosis of electrocution deaths.

We found that upper extremity was involved in 47 cases, lower extremity in 20 and both in 8 cases. We found that denudation of epidermis with central depression was seen in 55, zone of redness in 16 and no abnormality in 4 cases.

Guntheti *et al.* [10] found that a total of 55 electrocution deaths were identified from the autopsy cases at the statewide medical examiner system. More males died of electrocution than females with its ratio of (M: F) = 9:1. Of the 55 cases, 67.3% were White, 18.2% were African-American, 12.7% were Hispanic, and 1.8% were other races. The age of the victims ranged from 4 to 83 years with mean age of 40 years. >96% deaths due to accidents and

3.4% were suicide. The majority of deaths (70.9%) were caused by high-voltage circuits. Approximately 64% of fatalities were work-related accidents. The study indicated that electrocution deaths frequently affected young male workers who were in contact with a high-voltage currents while on the job. The detailed death scene investigation and autopsy findings are presented. The potential hazards of electricity must continue to be addressed in public safety campaigns to prevent such deaths. Strategies should ensure safe work environments for any contact with electric currents.

Conclusion

Authors found that maximum deaths were seen in males and denudation of epidermis with central depression was most common finding of skin.

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