

## **Cause of Death: Forensic Approach in Case of Fall with Fatal Blunt Force Trauma Combined with Electrocution.**

*Plamena Dineva<sup>1,2\*</sup>, Pavel Timonov<sup>1,2</sup>, Ivan Tsranchev<sup>1,2</sup>, Mirena Sotirova<sup>2</sup>,  
Kristina Hadzhieva<sup>1,2</sup>, Antoaneta Fasova<sup>3</sup>*

<sup>1</sup> Department of Forensic medicine and Deontology, Medical University of Plovdiv, Plovdiv, Bulgaria

<sup>2</sup> Department of Forensic medicine at UMBAL "St. Georgi" EAD, Plovdiv, Bulgaria

<sup>3</sup> Department of Anatomy, Histology and Embryology, Medical University of Plovdiv, Plovdiv, Bulgaria

\*Corresponding author e-mail: plamdineva@gmail.com

Industrial fallings from height as cases raise practical dilemma about the exact cause and the mechanism of death by forensic expert point of view. A 51-year-old man was subjected to a medico-legal autopsy at University Hospital St. George, Plovdiv, Bulgaria. An eye witness had seen the person sustaining injuries after a fall from a height from 3<sup>rd</sup> floor of construction building (around height of 10 meters). During the corpse examination a combination of two types of different trauma – electrical trauma and blunt force trauma, was stated. Such cases are extremely rare in the routine forensic practice and there usually is a serious diagnostic forensic dilemma about the exact cause and the exact mechanism of death. New forensic approach over the corpse tries to give conclusion about these categories and tries to fix these problematic points in the given case.

*Key words:* cause of death, diagnostic dilemma, fatal trauma, fall, electrocution

### **Introduction**

Electrocution is defined as death or severe injury caused by electric shock from the action of electricity going through body tissues and organs [9]. The word is derived from “electro” and “execution” and this term is usually used for fatal cases of accidents related to the general action of current over body. Deaths due to electric shock are significantly increasing despite different modern preventive strategies. These shocks are a leading cause of death especially amongst construction workers [8]. Established severe internal injuries at autopsy in such cases could be associated either with the

blast of the electrical discharge or with the secondary fall [10]. Falling from a height can be defined as the movement of the body to a lower level than the state it is on by different reasons leading to severe complex of life-threatening injuries. Contact with electricity, depending on the voltage, may produce contraction of muscle groups leading to rotating of arms, extending of feet, straightening of hips and knees, that can propel an individual forward or backward with additional initial falling from height [4]. Such cases raise practical dilemma about the exact cause and mechanism of death by forensic expert point of view.

**Case report:** A 51-year-old man was subjected to a medico legal autopsy at the Department of forensic medicine, St. George Hospital, Plovdiv. An eye witness had seen him sustain injuries after a fall from a height from 3<sup>rd</sup> floor of construction building (around height of 10 meters). At the crime scene a dead body was fixed lying on his face with blood collection around the face near a construction building. During the examination of the body on the scene additional electrical marks over upper limbs and lower right limb were established, in combination with additional burns over the working clothes of the body.

During the external examination of the corpse were found numerous lacerated wounds, bruises, and abrasions on the skin of the face over prominent parts, abrasions on the front site of the chest and abdomen, bruises, and abrasions over the upper and lower limbs. Electrical burns with different dimensions and shapes over the palms of the hands tips of the fingers (**Fig.1**) and sole of the right foot were also fixed. Lesions had yellowish to black discoloration of the burn site with raised borders and central crater.

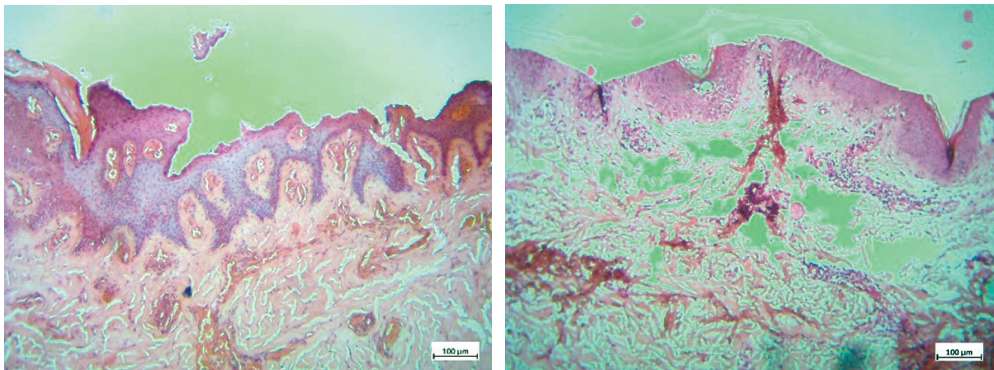


**Fig. 1.** Electrical burns over the palms

On the internal examination was found blunt force trauma on the head, chest, and abdomen. Trauma of the head was presented with fractures of the skull – frontal bone and base of the skull, subarachnoid hematoma, brain edema, soft tissues hemorrhage over the frontal area of the head. Chest trauma was manifested with serial fractures of ribs on both sides by anterior and middle axillary lines, fracture of the left clavicle, rupture of the lungs in the area of main bronchi near the bifurcation of trachea, contusions of both lungs, bilateral hemothorax – 1800 ml, rupture of pericardium and right atrium of the heart. Abdominal trauma was manifested with rupture of the spleen, handle-bucket tear of the mesentery and hematoma of the capsule of left kidney, in combination with blood collection inside peritoneal cavity with amount of 300 ml.

An additional microscopic examination of samples from the skin in the area electrical burns was performed and it showed a Swiss cheese appearance of epidermis. Routine toxicologic analysis of blood and urine samples collected from the body did not confirm evidence for any drug and alcohol concentrations.

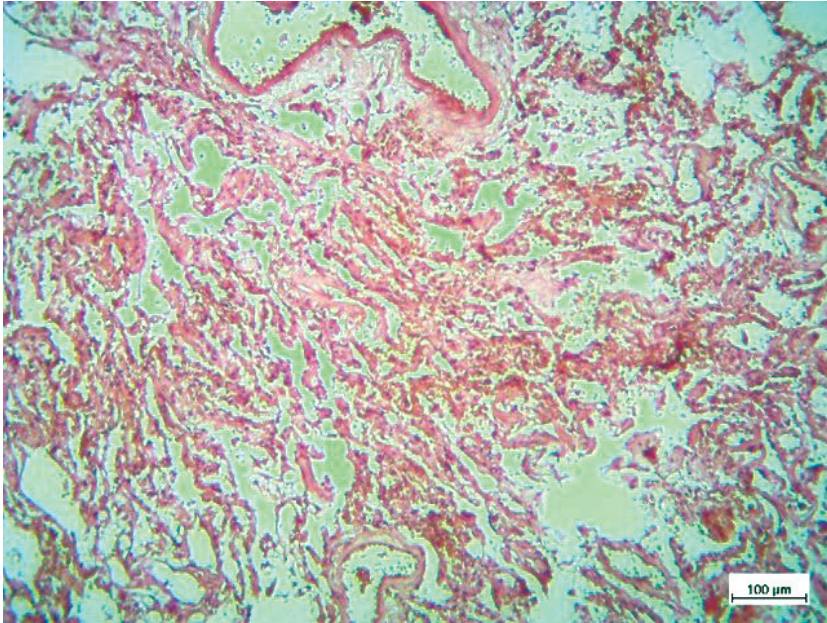
The microscopic examination of the skin showed that nuclei of epidermis specifically these of the basal layer were elongated and with pyknotic appearance. Some of the hair follicles also showed nuclear streaming with loss of epidermis in combination with intraepidermal and subcorneal separation (**Figs. 2, 3**).



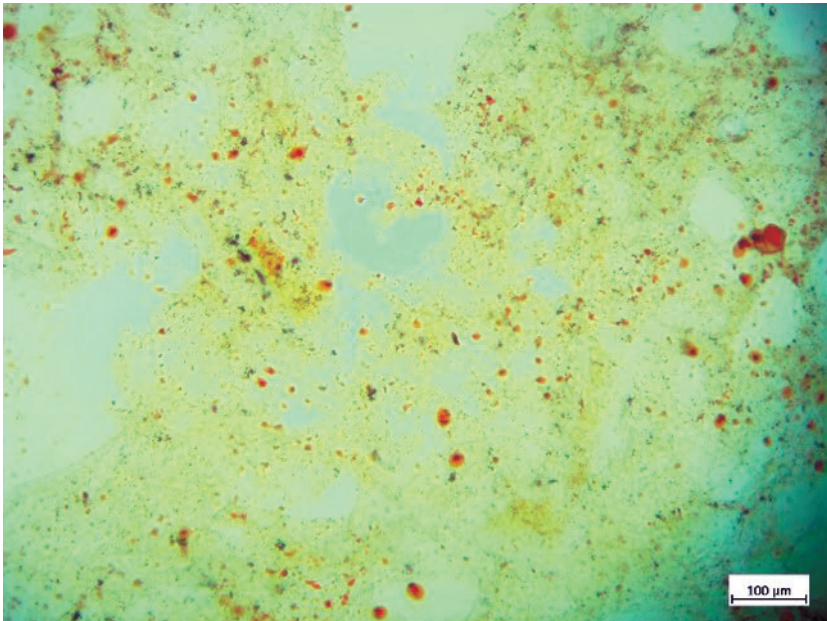
**Fig. 2 and Fig. 3.** Microscopic view of the skin – elongated nuclei of epidermis specifically these of the basal layer with pyknotic appearance in combination with intraepidermal and subcorneal separation.  $\times 20$

Hematoxylin-Eosin staining of lung tissues reveals diffuse intra-alveolar hemorrhages with alveolar disruption in combination with hemorrhagic changes inside interstitium. Sudan staining showed well seen orange-red fat globules, some of them with elongated shape, in the pulmonary parenchyma (**Figs. 3, 4**). In forensic expert practice confirmed predictor for vitality of trauma described by many authors is the presence of fat embolism that confirms active heart pump function and blood circulation.





**Fig. 4.** Hematoxylin-Eosin staining showing diffuse intra-alveolar hemorrhages with alveolar disruption in combination with hemorrhagic changes inside interstitium.  $\times 20$ .



**Fig. 5.** Sudan staining showing well seen orange-red fat globules, some of them with elongated shape, in the pulmonary parenchyma.  $\times 20$

## Discussion

Fatal accidents after electric trauma are related to increased risk to the life and health of people who are working in different industrial spheres of labour. Accidents during transport, exposures to harmful agents and falls represent the majority of fatal cases in this construction industry. This group of accidents includes all cases of electrical trauma, thermal trauma, chemical trauma, and radiation trauma. Fatalities due to electric trauma represent the majority of cases in this group of accidents [3, 7]. In Bulgaria almost all cases of electric trauma undergo investigation for different legal reasons [5].

Nevertheless, construction industry fatal accidents with combination of electrocution and falling from height are extremely rare. Electric trauma usually has accidental manner and it occurs in domestic settlements. Electrical burns are associated with higher morbidity and mortality with mechanism of direct damage to the tissues and organs. In such cases electrical marks could be the only external evidence proving the trauma, while during the internal examination of the corpse evidence proving this type of traumatism is usually lacking [15].

In fatal cases of electrocution, the mechanism of death usually is related to ventricular fibrillation. In this ventricular fibrillation consciousness may not be lost immediately [17]. This is because of the fact that the brain has approximately 10-15 s of oxygen reserve, irrespective of the heart. Thus, an individual can remain conscious for 10-15 s after cessation of the heart as a pumping organ [4]. In this situation the individual can sustain injury from falls and other associated trauma. Victims of electric shock may be thrown from a height that may lead to fractures and serious life-threatening injuries, even to death [14]. Usually, injuries by falling from height are divided into two main groups by mechanism of production: 1. injuries produced by initial impact of the body with the ground; 2. Secondary injuries. Severity and appearance of the traumatic complex depends on the height and the type of falling [1, 6, 11, 12, 13, 18].

In the present case all traumatic injuries are with characteristics of vitally achieved trauma and with characteristics of trauma, having inertial origin. The amount of blood inside chest cavity – 1800 ml is evidence for active heart pump function in the moment of trauma and confirms time of survival around several seconds. Around the fractures of all the bones well seen bruising of tissues was seen during the forensic examination of the corpse. Same finding was confirmed also by microscopic examination of muscle tissue taken from areas of injuries. An adequate heart pump function in combination with blunt force are the main factors, associated with the appearance and manifestation of injuries in the recent case – the presence of bilateral hemothorax, of hemoperitoneum, manifestation of contusions to the soft tissues and organs (especially the lungs) and fat embolism to the lungs.

The second most common cause of death in clear electrocution cases is from respiratory arrest from paralysis of the intercostal muscles and diaphragm. In each of these mechanisms of death in cases of electrical trauma during the autopsy should be

seen evidence of external and internal morphologic features of sudden, unexpected death - pinpoint hemorrhages, congestion and cyanosis of the face and the skin, cyanosis, and stasis of blood inside internal organs. In recent case autopsy findings are indicating different mechanism of the death - combination of severe internal blood loss with multiorgan disfunction due to mechanic destruction of tissues, confirming the exact cause of death.

## Conclusion

Accidents involving electrocution or falling from height are one of the most common reasons for morbidity and mortality in industry workers. When patients survive the initial trauma, they become serious therapeutic and diagnostic challenges to healthcare workers in emergency and intensive care units [2, 16]. The combination of these two types of traumas is extremely rare. In such cases there is a serious diagnostic forensic dilemma about the exact cause and the mechanism of death. A detailed examination of the crime scene involving forensic pathologist, a comprehensive forensic examination of the corpse and a detailed microscopic and laboratory examination are necessary for determination the mechanism, the cause, and the manner of death in such cases. A thorough study of the cases, including combination of electrocution and falls from a height in construction workers, would help prevent such injuries. This case also raises additional questions about the implementation of new strategies for preventing this type of traumatism.

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