K26 The Great Enigma of the Cause of Death in Burns: The Role of Forensic Toxicological Surveys—A Case Report and Review of the Literature

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Learning Overview: After attending this presentation, attendees will be able to show how the toxicological examination remains a crucial scientific piece of evidence in cases of death from thermal energy, especially when the autopsy does not clarify all aspects.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by emphasizing the role of toxicological investigation and the circumstantial data in order to investigate the correct sequence of events in a fire.

Traumatic injuries due to thermal energy include all the effects produced by exposure of the human body to temperatures that are too high or too low compared to the body's adaptability. The type of lesions sustained depends on the temperature level. Heat injuries can be determined by the increase in temperature, electricity, radiation, nuclear energy, or corrosive or caustic substances. The contact between a heat source and the body surface determines the production of burns on the skin. In some cases, the affected area is large, so that in addition to local effects, a systemic syndrome occurs that affects various organs and systems. Burns are a serious public health problem. Burns generally occur in domestic or work environments, but also as a result of traffic accidents, self-harm, or assaults.[1] Burns are classified, according to the depth of the lesion, as: first degree—epidermis; second degree—superficial dermis; third degree—deep dermis; fourth degree—deep soft tissues; and fifth degree—bones and joints.[2,3]

The analysis of thermal energy lesions is fundamental to establish the therapy and the prognosis for the patient. In the forensic field, the main purpose is understanding the cause and the modality of death. The injuries can be caused by a murder, an accident, or a suicide. In cases of death related to a fire, the autopsy is not always sufficient to establish the diagnosis and the manner of death. This study will demonstrate the determinant contribution of toxicological analysis in the diagnosis and reconstruction of the mode of death, in accordance with other data collected.

Reported here is the case of two boys found dead inside a commercial premise destroyed by fire. At the entrance to the room, it was noted that the interior had been destroyed by the flames, with evidence of an intense smell of flammable liquid. The 3D Computed Tomography (CT) excluded the presence of gunshots in both cases. In the first case, the autopsy showed deep burns, especially on the arms and legs, with black smoke spots on the palate. In the second case, superficial burns and the presence of soot in the glottis were detected. The percentage of carboxyhemoglobin and the presence of alcohol, drugs, or psychoactive drugs by mass spectrometry were investigated. The toxicological analysis showed in both cases that death was due to carbon monoxide poisoning in different percentages: 40.75% in the first case; 24.18% with presence of ecgonine and benzoylecgonine in the urine in the second case. In the first case, death was also due to burns spread by burning highly inflammable material.

The analysis of the cause of death in victims of fires is a great forensic enigma. In these cases, death may have occurred before, during, or after the fire. To reconstruct the event, the forensic pathologist must evaluate the circumstantial data during the inspection and investigate the signs of vitality at autopsy. Among these is highlighted the discovery of the soot in the glottis, in the trachea, and in the lungs, with the presence of extensive burns on the corpse. Often the signs present at the autopsy are not sufficient for diagnosis. In literature, a retrospective study on 107 firefighters showed that only about 65% of cases show signs of viability in the airways at autopsy. In the remaining cases, the signs are not significant or are even absent.[4] In these events, the role of toxicological investigation is crucial. Carbon monoxide levels are indicative that the victim was still alive at the time of the fire.[4-7] In this case, the toxicological data has been decisive for determining the cause of death, but has also contributed to defining the modalities of the event. This investigation, in agreement with the circumstantial data, suggested that the disaster had been caused by arson. The performing of 3D CT and autopsy remains essential to rule out other possible causes of death.[8]

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