G28 Fire Death of Two Lovers: An Immunohistochemical and Toxicological Study

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After attending this presentation, attendees will understand investigation of deaths due to phosgene intoxication and the importance

of an integrated analysis of histological and toxicological data to determine the manner and the cause of death in such cases.

This presentation will impact the forensic science community by underlining the importance of sampling and analyzing burned materials when phosgene intoxication is suspected. This compound is not detectable in body fluids and tissues due to its rapid conversion to hydrochloric acid.

The rate of annual deaths related to fire is about 13 per million inhabitants in the United States and Canada. These are mostly accidents followed by suicides. Homicides with subsequent burning of the victim or killings by burning are comparatively rare in Europe just as in the United States and Japan and are reported more often from India or South Africa.

The morphological findings in burned bodies may cover a broad spectrum. They can range from minor, local, superficial burns of the skin to calcined skeletal remains without any soft tissue left and total incineration. In most cases the effects of heat on the body continue beyond death, consequently, the changes found are largely of postmortem origin. The forensic investigation of deaths related to fire is important in order to determine the manner and cause of death and the vitality of the findings. The issues of vitality and cause of death are closely linked: the basis of the assessment is a careful evaluation of autopsy findings to distinguish morphological consequences of the effects of heat during life and after death.

A case will be presented where two burned bodies found early in the morning inside a joust (largely made of polyvinyl chloride – PVC and named "Wrestling labyrinth"), that burned in a town square after a festival. The victims were reportedly lovers (the boy 20 and the girl 16- years-old).

At external examination the corpses showed a typical boxer's attitude with general incineration, exposure of body cavities, bone fractures and partial amputation of extremities. To analyze the morphology of the fractures and their location a high-resolution computed tomography (CT) was performed, indicating that all fractures were a result of thermal effect.

Major internal findings consisted of hemorrhagic pulmonary edema and "puppet organs." Foam and soot particle depostis were detected inside the respiratory tract of both victims.

At histological examination of the lungs, ninety-five percent of the alveoli were flooded with edema and erythrocytes. There was no evidence of fibrin and inflammatory infiltrates. Immunohistochemistry, using epithelial (epithelial membrane antigen and cytokeratin) and endothelial (CD-34 and F-VIII) markers, revealed severe alveolar necrosis without endothelial damage of the vessels.

Systematic toxicological analyzes, performed on postmortem blood and urine, excluded alcohol and drugs intoxication. Monoxide- hemoglobin (CO-Hb) and cyanides concentrations were well below lethal values.

The presence of soot deposits and mucus inside the respiratory tract (not occluding the airways) along with a heat damage of the mucosa of the upper respiratory tract (edema, mucosal bleeding and vesicular detachment) suggest that the victims were alive during the fire and breathed fire-fumes.

The combined analysis of histological and immunohistochemical findings led us to identify the origin of the lung damage in the inhalation of an irritative gas. Laboratory tests, performed on burned samples of the joust (collected at death scene) and on samples of a similar undamaged joust, demonstrated an extensive production of phosgene during experimental burning.

Phosgene is a combustion, thermal decomposition or photodecomposition product of certain volatile chlorinated hydrocarbons (for example, trichloroethylene or perchloroethylene). These chlorinated hydrocarbon compounds can evolve phosgene if they come into contact with very hot metal, flame, or ultraviolet light. Phosgene is a colorless, extremely volatile gas which, at low concentrations, smells sweet, like freshly mown hay, whereas at high concentration has a pungent and

objectionable odor. When aspirated, it combines with the water of the mucous membranes being rapidly converted to hydrochloric acid, with subsequent injury to the lungs (hemorrhagic pulmonary edema).

In this cases, even in the presence of extensive direct thermal injuries, the integration of histological and immunohistochemical findings suggests as principal mechanism of death an asphyxia by airway submersion related to the inhalation of phosgene (called "dry land drowning"). Indeed, the detected hemorrhagic pulmonary edema was of such an extension (involving more than ninety five percent of the alveolar space) to be clearly incompatible with life, and capable of causing a rapid death.

In conclusion, the reported cases highlight the following teaching messages:

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1. Histological and immunohistochemical investigations may enhance the identification of the real cause and mechanism of death in fire accidents.
2. Sampling and analyzing burned materials may be of valuable importance when dealing with phosgene intoxications. This compound is not detectable in body fluids and tissues due to its rapid conversion to hydrochloric acid.

Phosgene Intoxications, Fire Deaths, Immunohistochemistry

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