



### G35 Death Due to Acute Respiratory Failure After Irritating Gases Exposure: Forensic Diagnosis

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After attending this presentation, attendees will become familiar with the injuries which should suggest the involvement of irritating gases in the death of a victim, in particular, the respiratory tract injuries (pulmonary edema and irritation of the respiratory tract mucosa). Finally, attendees will learn to perform the appropriate samples in such cases.

This presentation will impact the forensic science community by highlighting the risks of death after exposure to irritating gases by law enforcement agents or by an assailant with criminal purpose. With these case reports, the attendees will have help determining if death is consistent with irritating gas exposure, in taking into account the results of histological and toxicological findings, and predisposing factors to fatal outcome.

Irritating or incapacitating gases, in which "tear gases" or "lacrimatory gases" such as CS (ortho-chlorobenzylidenemalonitrile) or CN (chloroacetophenone) aerosols or other aerosol-dispersed chemicals, can be used by policemen to arrest offenders, to control riots, or by offenders to commit assault or robbery. Their physical toxicity is well documented, such as eye, skin, nose, mouth, and respiratory tract irritations. They are considered as non-lethal chemical agents but can be, nevertheless, responsible for acute pulmonary distress syndrome, lethal asphyxia, and death.

Here three cases of death by pulmonary failure after irritating gas exposure are reported: two obese men, 35-years-old and 50-years-old, respectively, were restrained by policemen at home, handcuffed behind their back, faced down on the ground, and died during the interpellation (cases 1 and 2); a third man, 32 years old, was discovered dead in a cave (case 3). Electronic Control Device (ECD) were used in cases 2 and 3.

Autopsy findings were asphyxia signs and conjunctival hyperemia in the three cases, conjunctival petechiae (cases 2 and 3), massive congestion of the mucosa of the trachea and the bronchial tubes in the three cases, overinflated lungs (in cases 1 and 3), massive congestive lungs (case 2), liver of cardiogenic shock (cases 2 and 3), and deep congestion of the organs in the three cases. A hypertrophic heart was discovered in the case 1.

Histological analyses showed hemorrhagic pulmonary edema (cases 1 and 2), partially necrotic (case 1), macrophage in the pulmonary alveoli or bronchi in the three cases, polymorph lung tissue with focal alveolar dilation, alveolar ruptures (case 3), focal necrosis and ulceration of the mucosa of the trachea with hemorrhagic suffusions (case 2).

Toxicological analyses found ortho-chlorobenzylidenemalonitrile in lung tissue and on the clothes of the deceased (case 2), but neither in the blood nor in the tracheal and laryngeal swabs (cases 1 and 2). Phosphoric and sulfuric acids were found on the tracheal and laryngeal swabs (case 3), derived from the ammonium phosphate and sulfate found in a fire extinguisher discovered on the crime scene. Cocaine (0.307µg/ml), cannabis (THC-COOH: 7.7ng/ml), alcohol (0.81g/l), and therapeutic level of doxylamine and valenfamine were found in blood (case 3).

In cases 1 and 2, it was concluded that death was caused by acute respiratory failure due to irritating tear gas exposure (ortho-chlorobenzylidenemalonitrile) in a closed space (apartment) with possible participation of postural asphyxia (cases 1 and 2) and shocks by ECOs (case 2).

In the third case, it was concluded that death was caused by acute respiratory failure due to the association of a chemical lung irritation by the fire extinguisher gas and an obstructive asphyxia by the fire foam. The involvement of drug intoxication and of the shocks by ECOs cannot be excluded.

**Conclusion:** In these three cases, acute pulmonary failure can be considered as a multifactorial cause of death. Nevertheless, irritating gas exposure is the main lethal factor in the three cases because of tracheal and pulmonary injuries and the presence of some residue of gas in samples performed. Furthermore, these three cases are illustrative of the predisposing factors to death in case of exposure to irritating gas: dispersed gas in a closed space, obesity, a person under the influence of drugs, prone restraint, and taser gun shocks.

**Tear Gases, Irritants, Pulmonary Edema**