H30 The Necessity of Glycolic Acid Testing in Suspected Antifreeze Ingestion Deaths

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After attending this presentation, attendees will be more familiar with: (1) Ethylene Glycol (EG) and its toxic metabolites; and, (2) the necessity of EG and glycolic acid testing in forensic toxicology laboratories.

This presentation will impact the forensic science community by discussing a specific case that illustrates the need for glycolic acid testing to be made readily available at all forensic toxicology laboratories.

EG, a colorless, odorless, yet sweet-tasting poisonous diol is found in antifreeze and other industrial products, including hydraulic brake fluids and de-icing solutions.[1,2] The intoxicating effects related to EG ingestion are similar to those of ethanol; however, an ingestion of approximately 100mL is reportedly fatal in most adults.[1] EG poisoning is often intentional and is responsible for approximately 5,000 poisonings each year in the United States.[3] Symptoms of EG poisoning include central nervous system depression, seizures, cardiopulmonary complications, acute renal failure, and delayed neurological sequelae.[1]

EG is metabolized into glycoaldehyde and then into Glycolic Acid (GA), which is metabolized further into oxalic acid and formic acid.[1] Much of the EG is excreted through the kidneys, while its acidic metabolites, especially GA and oxalic acid, account for much of the toxicity of EG.[1] The oxalic acid precipitates as calcium oxalate in the kidneys and into the vascular endothelium of the brain and other organs.[2] Clinical diagnosis of EG intoxication is challenging due to the lack of testing capabilities for EG in anything but large clinical laboratories.[1] Although forensic toxicology laboratories are able to perform testing for EG, most toxicology screening methodologies do not detect the substance; requests for specific EG testing is required. Testing for the acidic metabolites of EG is even more scarcely available, even though the severity of EG intoxication has been directly correlated to the concentration of GA.[1]

This presentation reports a case of a 25-year-old male, found deceased on the floor of a hotel room. A departure note was located in the room, in addition to an empty package of over-the-counter sleeping pills, antifreeze/coolant, toilet bowl cleaner, dietary supplements, an empty bottle of a sleep aid, and an empty bottle of vodka. It was unclear how long the individual had been deceased, as he had not been seen for approximately nine days. Mummification of the distal extremities was present, consistent with early decomposition.

A complete postmortem examination yielded no immediate cause of death. Toxicological testing of postmortem blood was positive for diphenhydramine (87.7ng/mL), nicotine, and cotinine. Toxicological testing of postmortem blood and urine samples for all other substances was negative. Additional specified testing for EG was negative, as well. Histological examination identified crystalline precipitates consistent with calcium oxalate crystals within renal tubules. Additional investigation uncovered screenshots from the decedent's cell phone that involved questions entered into an online search engine such as "how long does it take to die from antifreeze?". In an effort to correlate histological and investigative findings, repeat EG testing was requested, which was again negative. Subsequent GA testing on a postmortem blood sample was obtained at an outside laboratory, with positive qualitative results.

While EG testing was negative, confirmation was made, via histologic identification of renal calcium oxalate crystals and subsequent positive GA toxicology testing, that the death resulted from an intentional antifreeze/ethylene glycol ingestion. The decedent most likely survived for some time, while fully metabolizing the EG into its acidic metabolites, causing organ system malfunction and death. The case serves to emphasize the importance of histologic examination of the kidneys in order to identify EG-related deaths. Additionally, this case illustrates that, in some scenarios, EG testing may be negative, but the identification of GA can be used to confirm that the death resulted from EG intoxication.

Reference(s):

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3. Zoja, R., Andreola, A., Gentile, G., Palazzo, E., Piga, M., and Rancati, A. (2013). Histopathological findings of medico-legal significance in delayed death from ethylene glycol poisoning. *Australian Journal of Forensic Sciences.* 45(1), 37-42.

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