Forensic research extends detection of cyanide poisoning

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Researchers have found a new biomarker for cyanide poisoning, which may extend its detection window in death investigations by weeks if not months.

Unless cyanide is discovered at the time of death on the mouth or nose, elevated cyanide concentrations can only be found for up to two days under current toxicological testing. A team of researchers have found a substance that appears in the liver following cyanide poisoning that could serve as a stable biomarker for a longer period of time. The research, by Dr. Ilona Petrikovics, David Thompson, Sarah Martin, Prashanth Jayanna, and Jorn Yu of Sam Houston State University; Gary Rockwood of the U.S. Army Medical Research Institute of Chemical Defense; and Brian Logue of South Dakota State University, was recently published in two journals, *Biomarkers* and *Analytical Methods*.

Cyanide exposures commonly originate from smoke inhalation or direct exposure to either cyanide salt or hydrogen cyanide (HCN) and occur in military, firefighting, industrial and forensic settings. In fact, the study is an byproduct of research to find a antidote for those exposed to cyanide from a bioterrorism attack.

In the investigation of deaths, a bitter almond odor emanating from the victim and the presence of pink lividity during postmortem examination are two common indicators of acute cyanide poisoning. Alkali burns of the gastrointestinal tract often can be observed during autopsy in cases where cyanide salts have been ingested.

Since cyanide salts are solid crystalline, their presence in a crime scene or in the areas near victim's nose or mouth can be easily discovered, collected and preserved for further forensic testing. In cases where no suspicious substances are observed in the scene of the death, the presence of cyanide in the victim's body can be confirmed chemically using a colorimetric test, followed by a laboratory analysis using a gas chromatography–mass spectrometry (GC-MS).

Forensic evidence, such as stomach contents and whole blood of the victims, are usually collected and analyzed in order to confirm the cause of death. The toxicological detection of cyanide involves extraction and measurement of HCN from biological extracts. Blood or urine can be collected from the victim for laboratory analysis. Due to the relatively short half-life of cyanide (from minutes to hours depending on the matrix), toxicological detection of cyanide to confirm cyanide poisoning may only be feasible within the first few hours following exposure. Moreover, the volatility and reactivity of cyanide leaves direct measurements highly susceptible to errors introduced during the sample collection and separation step.

Cyanide levels in blood samples taken at autopsy the next day have been reported to decrease by approximately 79 percent. Postmortem formation of cyanide may also occur and complicate the interpretation of cyanide results. Therefore, the presence of cyanide becomes less feasible when the detection window is passed or the victims' body has been damaged by fire or advanced decomposition. The detection of stable biomarkers of cyanide is needed to extend the time in which cyanide exposure can be reliably assayed in a post mortem examination.

A recent study found that a biomarker, ACTA (2-aminothiazoline-4-carboxylic acid), was found significantly increased in liver samples following a sub-lethal dose of cyanide. The laboratory continues to work on ATCA's in vivo behavior and stability in order to

explore the potential of using ATCA as a biomarker for cyanide poisoning. Future research may include looking for the presence of ACTA in the bones of victims with cyanide poisoning to extend detection methods even further.

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