K71 Asphyxia Due to Inhalation of Hydrogen Gas

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After attending this presentation, attendees will understand a unique case in which suicide by asphyxiation using hydrogen was suspected. The detection of hydrogen in postmortem specimens was performed using Headspace/Gas Chromatography/Thermal Conductivity Detection (HS/GC/TCD).

This presentation will impact the forensic science community by providing a method for the detection of hydrogen in postmortem specimens, allowing a toxicological confirmation for cause of death.

Suicide via asphyxia using inert gases, most commonly helium or nitrogen, has become more common in recent years. Asphyxiation under these conditions results from the inhalation of inert gas instead of oxygen; unconsciousness can occur in as little as one minute. For these kinds of cases, the typical signs of asphyxia include cerebral and pulmonary edema, congestion of internal organs, petechial hemorrhages, and frothy edema in the respiratory tract. These signs are sometimes present, although there are often no significant postmortem abnormalities.

Hydrogen is the most abundant element and is also the lightest element on the periodic table. It exists as a diatomic gas, H_2, at standard temperature and pressure. Hydrogen gas is used in a variety of different areas, including fossil fuel processing and ammonia production.

A 50-year-old man was found dead by his wife in his home office with a large blue recycling bag over his head with tubing coming from the bag and attached to a pressurized tank of hydrogen. The carbon monoxide alarm was going off in the house. He was a mechanical engineer for the National Aeronautics and Space Administration and had access to various gases and chemicals. His wife stated that the decedent often took pressurized tanks home and left them in his office.

Alcohol and drug screens, as well as carboxyhemoglobin analysis, performed on this case were negative. Postmortem specimens were analyzed for the presence of hydrogen using a method that had been developed originally for cases in which helium was used as an asphyxiant to commit suicide. At the time of autopsy, samples of lung, brain, blood, and fat were collected and sealed in 22mL headspace vials by the forensic pathologist. Each specimen was analyzed using HS/GC/TCD, with separation performed at 50oC (isothermal) on an HP-Molesieve column using argon as the carrier gas. This method is capable of separating several gases, including nitrogen, oxygen, hydrogen, and helium. The vials were incubated at 38oC for two minutes, then 100µL of headspace was removed from the vial and injected into the GC.

Hydrogen was found to be present in all samples analyzed. The Limit Of Detection (LOD) for this case was determined using the peak areas present in the negative controls; the average of these was 8.75×10^4. Each of the samples analyzed had peak areas of an order of magnitude greater than the LOD. Additional assays were performed on cases in which hydrogen was not suspected to rule out presence in postmortem specimens. This method of analysis will not be useful in cases of moderate to advanced decomposition due to the number of gases produced during decomposition.

In conclusion, this analysis provides a method for detection of hydrogen that aids medical examiners in the determination of cause and manner of death. Additionally, these assays are easily conducted, both in specimen acquisition and toxicological analysis.

Hydrogen, Gas Chromatography, Postmortem