

CASE REPORT

Justin G. Krause,¹ D.O. and William B. McCarthy,¹ B.A.

Sudden Death by Inhalation of Cyclopropane

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ABSTRACT: This paper reports the case of a 22-year-old white male who was found dead in a storage room as a result of a fatal ingestion of cyclopropane. Cyclopropane is a sweet-smelling, irritating gas. Autopsy findings revealed congestion and hemorrhagic edema of the lungs, congestion of the trachea, and early autolysis. Cyclopropane was determined by headspace gas chromatography and mass spectrometry. To our knowledge, this is the first reported fatality involving cyclopropane.

KEYWORDS: toxicology, pathology and biology, cyclopropane, death

Cyclopropane, or trimethylene, was first prepared by chemist Freund in 1882. Nearly 50 years later, in 1929, Lucas and Henderson [1] of Toronto noted that it possessed better anesthetic properties than propylene, in which they were primarily interested. In 1933, Waters and his colleagues [2], at Madison, Wisconsin, introduced cyclopropane into clinical anaesthesia.

Cyclopropane is a pleasant, sweet-smelling gas, which is irritating to the respiratory tract when inhaled in concentrations over 40%. The molecular weight is 42.08, and the vapor density 1.42 (air = 1); because it is heavier than air, it tends to gravitate towards the floor. Cyclopropane, when inhaled, is absorbed from the alveoli and carried in the circulation^a attached primarily to the red cells by virtue of their high protein and lipoprotein content. Some is attached to the serum protein, but since the solubility of cyclopropane is relatively low (0.204, as opposed to 15.61 for ether), only a small portion is physically dissolved in the plasma. Cyclopropane is excreted almost entirely by the lungs, although a small quantity is lost through the skin [3].

Case Report

A 22-year-old white male fourth-year chemistry student was discovered lifeless on the floor of a locked storage room containing equipment and supplies for three different laboratories. The student was seen going to the storage room around 4:00 p.m. the previous afternoon as part of his job as a paid student lab assistant. He was discovered approximately 22 h later by a graduate assistant who entered the room to make a routine check of equipment for another

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¹Greene county coroner and chief investigator, respectively, Greene County Coroner, Xenia, OH.

lab. The body was fully clothed. Clenched between the legs was a disposable surgical glove containing a flat metallic object. The significance of this evidence was not fully appreciated until the following day, after an inventory had been completed by the three labs who shared space in the storage room. After receiving word that a cylinder of cyclopropane was out of place and found near where the body was discovered, we determined that the glove found on the body was placed over this cylinder and inflated by opening the valve with a cylinder wrench inside the glove. After the glove was sufficiently inflated, the cylinder was shut off using the wrench inside the glove. The inflated glove was placed over the nose and mouth, and the gas was inhaled with the wrench remaining inside the deflated glove, apparently resulting in the immediate collapse of the student.

In addition to a complete examination of the air-handling system to rule out any environmental causes for the death, a background investigation was performed on the student, revealing previous experimentation with nitrous oxide inhalation, recreational marijuana usage, and alcohol abuse. He was on a maintenance level of lithium for a previous manic episode which had required hospitalization four years earlier.

An autopsy was performed approximately 41 h after death. Microscopic examination revealed congestion and hemorrhagic edema of the lungs, congestion of the trachea, and early autolysis. Toxicological examination of the blood revealed no evidence of ethyl alcohol, drugs of abuse, or salicylates. Cyclopropane was determined to be present in the headspace of the blood and lung. The original Matheson cylinder of cyclopropane recovered at the scene was taken to the laboratory to be used as a reference standard. Gas chromatography headspace and mass spectrometry were performed on the samples, determining the presence of cyclopropane. Because standards for toxic inhalation levels were not available, concentration levels were not calculated. Consideration was given to the circumstances surrounding the death suggesting the presence of cyclopropane; substantiation was found through examination of the lung tissue.

Discussion

In summary, we report the first case, to our knowledge, of death as a result of inhalation of cyclopropane. Recent investigations into deaths occurring on university campuses within our jurisdiction have revealed at least two cases of accidental death through inhalation of foreign substances. Both of the substances belonged to animal experimentation laboratories and either were stolen and taken off-campus or were experimented with on-campus. Statistically, our on-campus death rate per student population is quite low. However, since this university caters primarily to the commuter student, accurate statistics concerning student deaths occurring off-campus are unavailable. Since the opening of the campus ten years ago, we have investigated three suicides and two fatal accidental inhalations of toxic substances.

References

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Address requests for reprints or additional information to
Justin G. Krause, D.O.
Greene County Coroner
1141 N. Monroe Dr.
Xenia, OH 45385