CASE REPORT

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A Double Homicide As a Result of Chloroform Poisoning

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ABSTRACT: Homicidal poisoning using chloroform has been reported infrequently. Presented is a case of a double homicide involving a 29-year-old male and his 23-year-old fiance. Gas chromatographic methodology and tissue concentrations of chloroform are presented. Evidence strongly suggests forced inhalation using an impregnated cloth.

KEYWORDS: pathology and biology, criminalistics, chloroform, homicide

Chloroform (trichloroform, trichloromethane), a halogenated hydrocarbon initially prepared in 1831, is found principally in industry and the laboratory. Reports of homicidal deaths as a result of chloroform poisoning are infrequent. Presented is a case of a double homicide where chloroform was used as the poisoning agent.

Case Report

On an evening in March, investigators from the Ramsey County Medical Examiner's office were summoned to the Midway district of St. Paul after the discovery of 2 bodies in a private residence. The deceased subjects were a 29-year-old white male and his 23-year-old fiance. The victims had been discovered in the male subject's residence, a second-story apartment in a two-story duplex. According to police reports, the family members had not seen or heard from the deceased couple for 4 days. At the request of the next of kin, police began a search for the couple. When police officers entered the male subject's apartment as part of the search the bodies were discovered.

Officers at the scene reported finding the front door of the house locked with a spring-type lock that could be engaged by pulling the door shut. The inner hallway door to the subject's apartment was closed but unlocked. No evidence of forced entry could be appreciated.

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The inside of the apartment was found to be neat and well-ordered with the body of the male victim observed lying in a prone position on the floor of the living room near the front door. The body of the female was discovered lying supine on the bedroom floor next to the bed (Fig. 1). Examination of the bodies at the scene found both to be dressed in normal attire for the season. Both subjects were cold to touch and livor mortis was fixed and appropriate for their positions. Rigor mortis had passed off and the late postmortem interval had been entered with changes of postmortem decomposition. Within the living room, near the male subject's body, a round coffee table was observed in front of a davenport. On top of this table were a number of self-sealing, clear plastic bags, the bottom part of a bong pipe, and remnants of dried, green plant substance later identified as marijuana. A thorough search of the scene failed to reveal any other drugs nor was there any evidence of prescription medications, alcoholic beverages, or containers.

Within the bedroom where the deceased female was discovered, a large brass bed was found stripped of all sheets, pads, pillow cases, and blankets. No such soiled bed linen could be found within the apartment. Personal items belonging to the deceased couple including a purse, wallet, and so forth were present at the scene with exception of the female subject's car keys. A thorough search of the premises failed to find these keys. Police investigating the surrounding area discovered the female subject's car abandoned in a motel parking lot 3 miles (5 km) from the death scene. No car keys were present within the automobile. Subsequent questioning of relatives and friends revealed both subjects to be happy, well adjusted, and planning for their upcoming wedding.

The bodies were removed from the scene to the Medical Examiner's office where a postmortem examination revealed a normally developed, normally nourished, adult male and female. Both subjects were dressed in an appropriate fashion. All articles of clothing were without note. External examination of both subjects revealed evidence of postmortem decomposition with bloating of the abdominal cavities, discoloration of the soft tissues, intravascular hemolysis, and mummification of the distal fingers. No evidence of traumatic injuries could be appreciated on either body with the exception of superficial abrasion-type injuries confined to the lower anterior facies of both subjects. In the female these abrasions had a patterned appearance and extended across the infraorbital region of the cheeks with involvement of the tip of the nose as well as the cheek and perioral region. The upper and

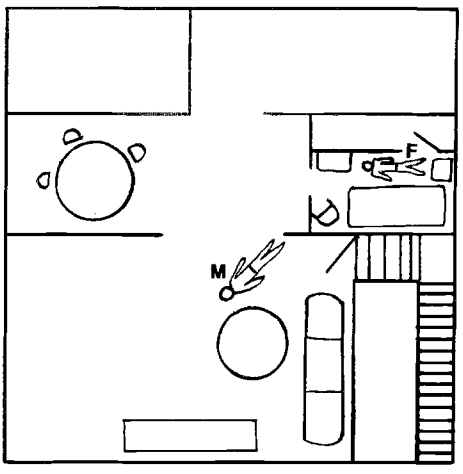


FIG. 1—*Diagrammatic layout of apartment showing male* (M) *and female* (F) *victims' location when initially discovered.*

lower lips displayed similar injuries with dried, white purge-like material covering the teeth, lips, and cheek surfaces. The anterior facies were congested with a diffuse fine petechial rash noted in the periorbital region as well as on the dorsum of the nose and forehead (Fig. 2). In the male subject similar abrasion-like injuries were noted on the left cheek and lip regions with dried, purge-like material present on the lips as well as on the hairs of the moustache and beard (Fig. 3). Internal examination of both subjects was unremarkable with multiple organ systems displaying evidence of postmortem decomposition on gross and microscopic examination.

Specimens obtained from both subjects during the postmortem examination included vitreous fluid, heart blood, bile, bladder urine, gastric contents, kidney, brain, and liver as well as swabs from the oral and nasal regions. Whole blood specimens were placed in sterile, 10-cm^3 glass test tubes with rubber stoppers and containing potassium oxalate and sodium floride additive. Samples of vitreous fluid as well as centrifuged serum were retained in sterile, 10-cm^3 glass test tubes without additives. These specimens were stored at 3°C (37°F).

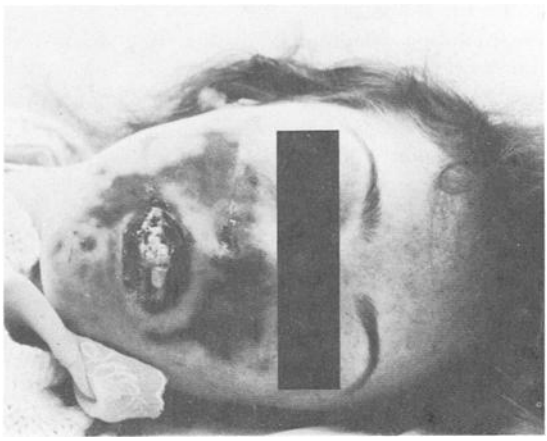


FIG. 2—*Female victim with abrasion-type injuries across cheeks, nose, and perioral regions. Note petechial rash covering forehead and periorbital regions.*

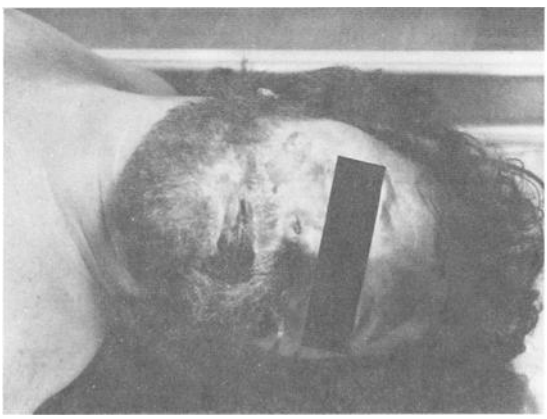


FIG. 3—*Male victim with abrasion-type injuries on cheeks and perioral regions.*

Bile and gastric contents were placed in sterile plastic containers with screw tops while tissue samples from the brain, liver, and kidney were separately sealed within polyethylene heat sealable pouches. These specimens were immediately frozen and stored at −20°C (−4°F).

Analysis of the above specimens in the Medical Examiner's toxicology laboratory failed to reveal the presence of ethyl alcohol, carbon monoxide, sedative-hypnotics, antidepressants, cocaine, narcotics, phencyclidine, or marijuana metabolites. No odor was noted on examination of tissue samples or gastric contents. A screen for volatile compounds using a gas chromatograph detected the presence of chloroform in specimens from both subjects (Table 1).

Toxicology

A Beckman GC-65 equipped with a flame-ionization detector (FID) detector and a 1.8-m (6-ft) by 2-mm inside diameter (ID) glass column, packed with 5% carbowax—20 m on 60-80 Carbopak B (Supelco) was used. The column temperature was 80°C helium carrier gas flow 40 mL/min, and injector and detector temperatures 150°C. A headspace sampling technique was used for the analysis [*1*].

A chloroform stock solution was prepared by dissolving 98 mg of chloroform in 1 mL of ethyl alcohol diluting to 100 mL with water (98 μg/mL).

Suitable working standards of chloroform were prepared in the range of 30 to 60 μg/mL. In blood and tissue homogenates (1:1 in water), a *N*-propyl alcohol internal standard was prepared to give a concentration of 300 μg/mL. In water, 1 mL of body fluid and 1 g of tissue were used for chloroform analyses.

A standard curve was prepared by using 1 mL of reference and 1 mL of internal standard in a 20-mL vial sealed and equilibrated at 45°C for 30 min. A 0.5-mL headspace sample was used for the analysis.

The stomach contents were diluted ten times to give a proper response under the above conditions. Unknown tissue samples were sliced thinly in frozen conditions.

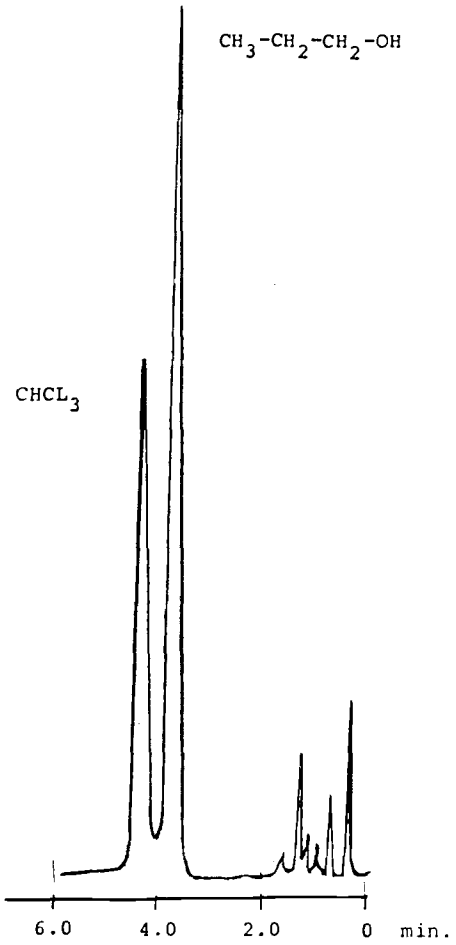
Chloroform was confirmed in tissue and blood employing a Finnigan Model 3100 gas chromatograph/mass spectrometer (Finnigan MAT, Sunnyvale, CA). A 1.8-m (6-ft) by 2-mm ID glass column packed with 3% OV-1 on 100–120 mesh Gas Chrom Q, helium carrier gas flow of 10 mL/min, column temperature of 50°C, and injector temperature of 250°C were used. A scan from 10 to 150 AMU each second was employed. In the splitless mode 0.5 mL of head space was injected.

Chloroform was quantitated in blood, bile, urine, stomach contents, lung, liver, brain, and kidney (Table 1). These specimens were also screened for other volatile components; none were detected. The GC and GC/MS of the brain specimen are shown in Figs. 4 and 5.

TABLE 1—*Chloroform concentrations[a] from female and male victims.*

	Female	Male
Blood	130.96	not available
Bile	15.7	not available
Liver	63.65	123.08
Brain	54.46	133.27
Kidney	65.37	124.11
Gastric contents	7.1	539.6

[a]Microgram/millilitre or microgram/gram.



l—Chromatogram on 5% carbowax liquid phase of a brain specimens from decedent.

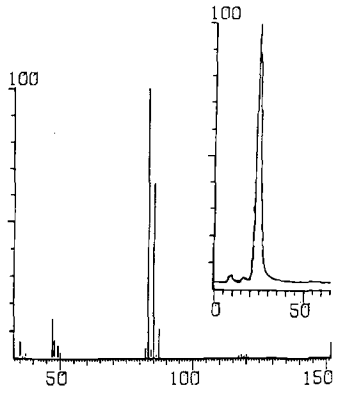


FIG. 5—*Electron impact mass spectrum of a brain specimen from decedent.*

Discussion

Homicidal deaths as a result of chloroform poisoning have been infrequently reported in the English language forensic science literature. In 1930, Gettler reported 16 chloroform related fatalities, 1 of which was a homicide [*2*]. Gonzalez noted that from 1918 to 1951 the Chief Medical Examiner's office of New York City recorded 5 homicidal deaths as a result of chloroform poisoning [*3*]. Bonnichsen and Maehly in their 10-year survey included 2 homicidal poisonings from a group of 6 chloroform related fatalities [*4*].

Chloroform's primary means of entrance into the body is by inhalation through the respiratory system, although absorption through the gastrointestinal tract as well as the intact skin has been noted [*5,6*]. The literature describes homicidal deaths as a result of forced inhalation of chloroform when a saturated towel or cloth was placed over the victim's face [*3,4*]. Cases of accidental and suicidal chloroform poisonings have been reported in the literature with the mode of administration including inhalation, oral ingestion, and intravenous administration [*7–10*].

Absorption of chloroform is rapid with wide distribution occurring throughout the body. The majority of inhaled chloroform is excreted unchanged by the lungs. Any remaining drug within the body will be eliminated over a period of hours with about 4 to 5% of the total inhaled amount being metabolized. VanDyke et al. [*11*] found that a single injection of ^{14}C labeled chloroform $^{14}CO_2$ appeared in expired air in less than 1 h and was still being expired 12 h later. Four to five percent of the total dose was exhaled as $^{14}CO_2$ and up to two percent of ^{14}C labeled metabolites were noted within the urine. Paul and Rubenstein [*12*] noted that when chloroform was administered intraduodenally to rats 70% of the dose was recovered unchanged through the lungs with 4% converted to carbon dioxide.

Chloroform exerts a direct depressant action on multiple organ systems within the body. The primary effect is central nervous system depression which can lead to anesthesia and narcosis. Direct and reflex depression of the cardiovascular system can occur affecting the myocardium, conducting tissue, and peripheral vessels. Depression of the respiratory system results from a direct effect on the respiratory center [*13,6*]. The immediate effect of chloroform intoxication is unconsciousness [*8*].

Gonzalez et al. [*3*] have suggested that while a blood concentration of 0.4 to 0.8 g/L of chloroform is dangerous to life, the fatal dose is variable. Dreisbach [*14*] states that 10 mL is considered fatal when either ingested or inhaled, however, an individual survived an oral dose of 180 mL [*5*]. Timms and Moses [*10*] have reported on a nonfatal case of chloroform toxicity following intravenous administration of 5 mL of chloroform. The mean lethal dose for an adult is about 30 mL [*15*].

Conclusion

In our case, the epidermal burns present on the subjects' facial areas are suggestive of forced inhalation, possibly with a chloroform impregnated cloth or rag as described by Gonzalez. The petechial rash observed in the female subject suggests an asphyxial component in her death related to an obstructing of the mouth and nasal passages. The male subject, while exhibiting similar findings in the facial regions, was noted to have comparatively elevated levels of chloroform in his specimens. The concentration present within the gastric contents suggests possible swallowing of some of the chloroform during the fatal assault.

After extensive investigation this case remains open with no charges filed.

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