CASE REPORT

Michael E. Ward,[1] *M.D. and Richard F. Meyerhein,*[2] *M.S.*

Diethyl Ether, a Chemical Asphyxiant Used as a Prelude to Homicide: A Report of Three Cases*

REFERENCE: Ward ME, Meyerhein RG. Diethyl ether, a chemical asphyxiant used as a prelude to homicide: A report of three cases. J Forensic Sci 1997;42(2):344–348.

ABSTRACT: Homicides in which the victims are first subdued with a chemical asphyxiant are unusual and quite rare. We report three cases in which victims were first overcome by ether containing compounds and then killed by other means of asphyxiation. The ether containing compounds used in these three cases were readily available commercial products. In two cases, the distinctive spectra of the volatile compounds in the decedents' blood, from the gas chromatograph and from the gas chromatograph/mass spectrometer, were compared with suspect ether containing products recovered during the scene investigations. In one case, an identical match was obtained. In the other case, the chromatographic spectra differed slightly from the compounds found at the scene, but the difference was explainable by metabolic breakdown of the compounds in vivo.

KEYWORDS: forensic science, forensic pathology, forensic toxicology, diethyl ether, ether, homicide, chemical asphyxiation

Diethyl ether (ether), a volatile, flammable liquid was introduced in 1842 as an anesthetic agent, to allow painless surgery (1). It could be made chemically in a pure form, was easy to administer, and did not suppress respiratory or circulatory function at surgical levels of anesthesia (2). Because of these advantages, ether was widely used in many countries as an anesthetic agent. However, certain properties made ether a less than ideal anesthetic agent. High solubility in body fluids and tissues resulting in a lengthy induction and recovery time (3), an unpleasant odor and a tendency to cause nausea and vomiting (4), and high flammability making its use in operating rooms, with ever increasing numbers of electric devices, quite hazardous (5).

Ether is now used primarily as an industrial solvent, and as a component in many commercial products. For example, a commonly available product marketed as a cold weather starter for automobiles and heavy machinery combines ether with other organic compounds in a spray mixture. This type of commercially available product is frequently found around the home.

Ether has been described in both accidental and suicidal deaths. However, a review of the medical literature failed to uncover cases in which ether, and/or ether containing compounds, were used to disorient, or render helpless, victims who were later killed by other means of asphyxiation. A review of the files of the Office of the Medical Investigator for the State of New Mexico revealed three of these unusual and rare cases.

Case One

A 34-year-old woman was reportedly found dead in bed. Superficial linear abrasions were on the nose, and multiple intramuscular hemorrhages were present within the strap muscles of the neck. Toxicological examination using gas liquid chromatography revealed ether in blood (9.0 mg/dl) and gastric contents (17.0 mg/dl). The cause of death was manual strangulation, with the contributory effects of ether intoxication.

Case Two

A 30-year-old woman was found dead by a friend in a locked bathroom. When found, she was nude and submerged in the bathtub. An autopsy revealed multiple abrasions about the nose and mouth, lacerations of the lower lip and frenulum, and conjunctival petechial hemorrhages. Many areas of reddish discoloration were over the chin and right side of the face, felt to be consistent with chemical burns. White froth was present in the mouth and trachea, and the lungs were congested (Fig. 1). Toxicological examination of autopsy specimens using gas chromatography revealed ether in tracheal air, lung, gastric contents, and blood (170.0 mg/dl). The cause of death was drowning. Contributory was ether intoxication.

Multiple cans of ether containing compounds were recovered from the decedent's home and from the home of the suspect. A gas chromatogram of the decedent's brain was compared with chromatograms of these suspect samples. The comparison with one of these samples is shown in Fig. 2. Major chromatographic peaks were nearly identical in their retention times and ratios. Breakdown of the compound and its components in the sample from the victim was noted especially at the lower retention times or highly volatile region. The pattern from the victim was felt to be consistent with the compound recovered from the suspect's home.

[1]Deputy Medical Examiner, Office of the Medical Examiner, Greenville County, Greenville, South Carolina; Pathology Associates of Greenville, Greenville, South Carolina.

[2]Supervisor of Organic Laboratory, Scientific Laboratory Division, Department of Health, Albuquerque, New Mexico.

*Presented in part at the 46th Annual Meeting of the American Academy of Forensic Sciences, San Antonio, TX, February 1994.

Received 10 April 1996; and in revised form 5 Aug. 1996; accepted 7 Aug. 1996.

FIG. 1—*Abrasions, laceration and contusions of lips.*

Case Three

A 50-year-old woman was found partially buried face down in a 4-ft garbage pit. Excavation of the pit revealed a woman with changes of early decomposition, and a black plastic bag that contained vomitus material and a strong volatile odor. Many pieces of household trash including a near empty can of an ether containing engine starter fluid were also found.

At an autopsy, there was fixed anterior livor mortis, diffuse scleral hemorrhages, skin sloughing of the face with early autolytic changes of visceral organs, and a distinct volatile odor emanating from the body. No significant antemortem injuries were noted. Toxicological examination of autopsy specimens using gas chromatography/mass spectrophotometry (GC/MS) revealed ether in brain, lung, tracheal air, and blood. The recovered can of starter fluid was also analyzed by similar methods and compared with the chromatogram of the decedent's blood (Fig. 3). Chromatographic peaks were nearly identical in their retention times and ratios. The signature pattern of the compound was compared with the library of known mass spectra. Signature peaks were identified as diethyl ether, 2-methylhexane, 3-methylhexane, heptane and toluene (Fig. 4). The cause of death was mechanical and chemical asphyxiation.

Discussion

Before the discovery of the anesthetic properties of diethyl ether (ether), nitrous oxide and chloroform, dental extractions and surgeries were dreaded procedures done almost exclusively in the emergency setting. Surgeons and dentists were better known for their speed than their skill, and careful dissection techniques, often mastered at the autopsy table, fell to the wayside. Not until the 19th century did the mind altering ability of ether and nitrous

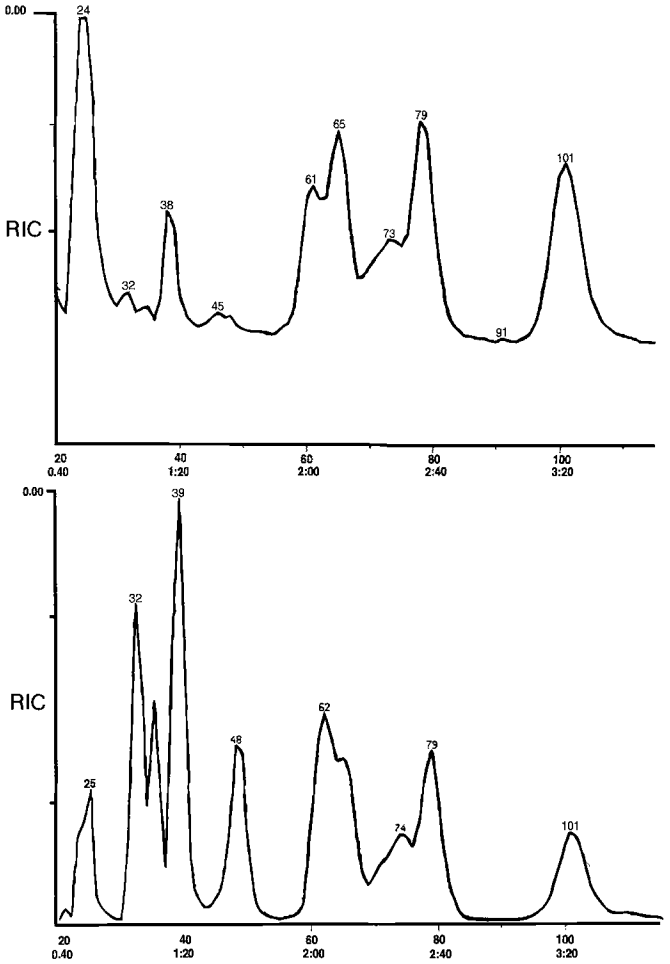

FIG. 2—*Comparison gas chromatogram of decedent's brain headspace and a volatile compound recovered from the home of the suspect. Although peak ratios are different, retention times are very similar. Slight differences are likely due to an in vivo breakdown of volatile components (weathering).*

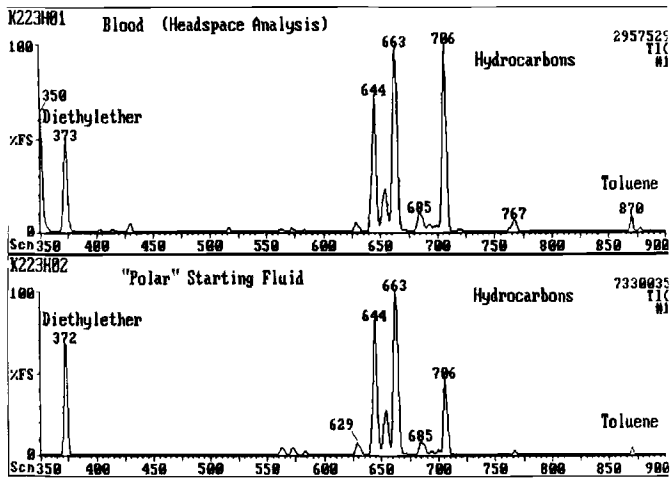

FIG. 3—*Comparison gas chromatogram of the decedent's heart blood* (top) *and starter fluid recovered at a scene* (bottom), *showing a near identical chromatographic match.*

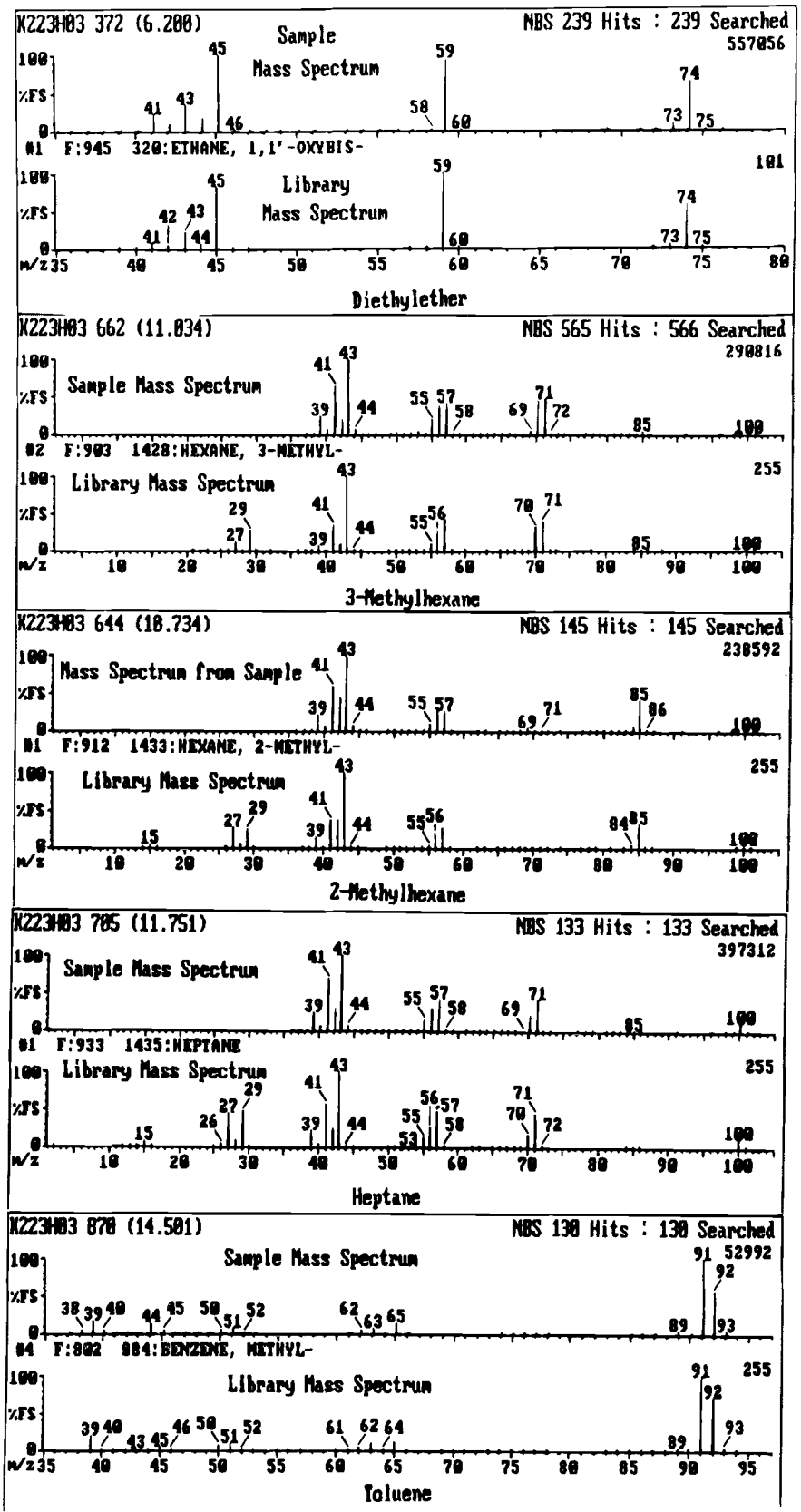

FIG. 4—*Mass spectral identification of gas chromatographic peaks of the decedent's blood. Peaks number 372 (Diethyl ether), 644 (2-Methylhexane), 662 (3-Methylhexane), 705 (Heptane), and 870 (Toluene).*

oxide become appreciated when participants of "laughing parties" and "ether frolics," who willingly inhaled gaseous ether, displayed insensibility to pain (1,6). In March of 1842, following one of these parties, a Georgia physician, Crawford Williamson Long, used ether as an anesthetic and painlessly removed a tumor from the neck of his patient, James Venable. Historically, this occurrence is held as the first use of a gas to render anesthesia during a surgical procedure; however, it remained unreported until 1849 (1,6,7,8).

The first reported use of gaseous surgical anesthesia occurred in Boston on October 16, 1846 at the Massachusetts General Hospital. William T. G. Morton, a dentist, and John C Warren, a surgeon, successfully anesthetized and painlessly removed a tumor from the jaw of Gilbert Abbot (1,6,7,9,10).

Following the report of successful surgical anesthesia, the use of ether quickly gained in popularity. With this increase in use, complications soon became apparent. A well-recognized complication of ether anesthesia was vomiting. Ether has since become a well-known emetic and modern studies describe emesis associated with ether anesthesia ranging from 30–50% (4). Ether anesthesia associated vomiting, especially before good control of the airway, resulted in operating room deaths with vomitus material filling the trachea (11). A very serious complication of ether, the flammability of ether vapors, became apparent soon after the introduction of ether as an inhalant anesthetic. The first reported anesthesia related fire occurred in Boston in 1850 when a heated cautery caused a flash fire in the mouth of a patient receiving ether anesthesia (12). Several patients and anesthetists were killed in operating room explosions while using ether with oxygen (13).

The initial popularity of gaseous anesthesia was soon replaced by warnings of its evil. Religious leaders spoke out against its use (14) and a prominent physician once wrote concerning ether that "the substance was unknown, capable of abuse, and could be put to use for nefarious ends" (15).

After personal involvement by one author (MEW) in case three, the files of the Office of the Medical Investigator for the State of New Mexico were searched over a 15-year period from 1978 to 1993. During this time, more than 18,100 autopsies were performed. Of these, 2,864 were determined to be homicide, of which only three were associated with ether exposure or use.

Deaths directly attributable to ether exposure through either ingestion or inhalation are most commonly described as associated with administration of anesthetic levels of ether without proper ventilatory support. Campbell described the postmortem distribution of ether in three deaths in which ether was used with other anesthetics. In these three cases, blood levels ranged from 60 to 375 mg/dl (16). Baselt described suicidal ingestion of as little as 30 mL of ether (17), and Burnett, et al. described a previously healthy teenager who died as the result of "intoxication of self applied ether" which he used as a treatment for seborrheic dermatitis of the scalp (18). Lechat, in a report to the French National Academy of Medicine reported the deaths of two drug addicts attributed to ether exposure (19), and Cooper, in 1848, described the death of a middle-aged female who was given ether anesthesia for the amputation of a fractured leg (20). More recently, Nashelsky, et al. described the homicides of three elderly females associated with the use of chloroform. In one case, the cause of death was strangulation (21). However, a review of the recent medical literature failed to reveal circumstances similar to the three cases described above in which a victim was first rendered unconscious or disoriented by ether or an ether containing compound, and then killed by other means of asphyxiation.

According to police records, in the three cases described above, each victim, a woman, was killed by her husband. In the first case, manual strangulation followed ether exposure. Low concentrations of ether were discovered in blood (9.0 mg/dl) and stomach contents (17.0 mg/dl). The type of ether compound used is unknown as toxicological examination using gas-liquid chromatography did not suggest other volatile hydrocarbons.

In the second case, the victim was exposed to an ether containing compound and was subsequently drowned in the bathtub. Autopsy findings of abrasions about the nose and mouth, lacerations of the lower lip and frenulum, and discolorations of the chin and face suggested firm pressure being placed over the mouth and nose with resulting injuries and chemical burns. Toxicological examination of blood and tissues recovered at the autopsy demonstrated various other hydrocarbons and ether at a level associated with deep anesthesia (170 mg/dl) (22). These hydrocarbon peaks were compared with gas chromatograms of numerous ether containing compounds found in the decedent's home and the home of the suspect. A probable match of suspect compounds and the decedent's tissues are shown in Fig. 2. An identical match was not obtained, most likely the result of weathering, or breakdown of the volatile compounds in vivo. This process is more pronounced at the lower end of the chromatogram that is the more volatile region.

The third case involved a middle-aged female who was overcome when a plastic bag containing an ether compound was placed over her head. She was then thrown into a garbage pit and covered with dirt resulting in mechanical asphyxiation and death. Postmortem injuries were present which were the result of the excavation process. GC/MS was used to examine body fluids and tissues. Ether and various hydrocarbons were detected and compared with the suspect material recovered from the burial pit. Figure 3, a chromatogram of the decedent's brain tissue, shows virtually identical chromatographic match. Mass spectra of the signature peaks identified the major hydrocarbon additives of the compound (Fig. 4). The same hydrocarbons were identified in the ether containing compound recovered from the scene.

Conclusion

Various ether containing commercial products are frequently found in homes across the country. With this accessibility, it is not surprising that these agents would be used during the commission of a crime. Each of the three victims described was a woman who was first rendered disoriented or unconscious by ether, and then killed by some means of asphyxiation. In one case, a gas chromatograph was used to compare other organic compounds found in body tissues with suspected sources of ether, and in another case, GC/MS was used and an identical match was obtained.

Ether can be detected in autopsy samples using a gas chromatograph. However simply determining the presence of an ether peak does little to identify the source of the volatile compound. Most commercially available forms of ether contain a mixture of many hydrocarbons of variable length, generically called hexanes. Identifying which hydrocarbons are present, and their ratio to each other may help identify the ether source. It must be kept in mind that these hexanes are commercially bought by the product manufacturer, and therefore, the signature pattern of the products may vary from each production lot. An identical spectral pattern match, therefore, not only identifies the product but often the production lot.

Medical Examiner's and forensic toxicologist's should be aware of, and suspicious of, the potential for use of ether during the commission of a homicide. Some reminders to the possible use of a volatile asphyxiant include chemical type burns present about

the nose and mouth, a volatile odor emanating from the body at the time of autopsy, and the presence of unexpected peaks seen during gas chromatographic analysis of body fluids for volatile substances. When ether is detected, the search for other organic compounds in autopsy specimens should be done, as these additional organic additives give the signature patterns necessary to identify the source of the ether.

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Additional information and reprint requests:
Michael Ward, M.D.
Pathology Associates of Greenville
8 Memorial Medical Court
Greenville, SC 29605