CASE REPORT

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Two Traffic Fatalities Related to the Use of Difluoroethane

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ABSTRACT: The 18-year-old white male driver and 17-year-old white male passenger of an automobile were killed when their vehicle crossed the median of a 4-lane highway and collided with a minivan. A can of airbrush propellant was found in the automobile of the deceased. The only drug detected during initial toxicological analyses was 130 mg/L ethanol in the blood of the driver. When performing ethanol analysis by headspace gas chromatography, an unidentified peak was observed in the blood of both deceased. This peak was identified as difluoroethane (Freon 152), the propellant in the aerosol can found in the automobile. The concentrations of difluoroethane in the blood of the driver and passenger were 78 mg/L and 35 mg/L, respectively. Based on a literature search we believe that this is the first report of the quantitation of difluoroethane in biological samples.

KEYWORDS: forensic science, forensic toxicology, difluoroethane, Freon, volatile substance abuse, headspace gas chromatography

The incidence of intentional inhalation of volatile substances (inhalant abuse, volatile substance abuse, solvent abuse, glue sniffing) is increasing in younger adolescents according to a three-year self-report survey of middle and high school students (1). Responding students in this study reported overall rates of 12.8% for lifetime use and 4.6% for past-month use with a trend of increasing inhalant abuse with younger cohorts. Annual surveys of high school seniors since 1975 have documented a lifetime incidence of inhalant abuse of 15–20% with 5–10% of seniors reporting use during the previous year (2).

Volatile substances preferred by inhalant users include hair spray or aerosols, airplane glue, gasoline, paint or solvents, marker pens or correction fluid and amyl or butyl nitrates (poppers). The abuse of volatile substances used as propellants in many different household aerosol products has been reported. The development of replacements of the ozone-depleting chlorofluorocarbons (CFCs) has led to the introduction of new compounds as propellants. One such compound is difluoroethane (DFE, halocarbon 152A, Freon 152), a colorless, odorless, highly flammable gas used as a refrigerant blend component and as a propellant in aerosol products. In 1995 there were 2 deaths attributable to fatal exposure to DFE reported in the Annual Report of the American Association of Poison Control Centers Toxic Exposure Surveillance System (3).

We report here the death of an 18-year-old male driver and 17-year-old male passenger following traumatic injury resulting from an accident incurred while operating a motor vehicle apparently under the influence of DFE.

Case History

The deceased were 18- and 17-year-old white males who were the driver and passenger respectively of an automobile that suddenly crossed the median of a four-lane highway and collided with a minivan. The driver of the minivan was critically injured and was left with serious and severe permanent injuries. The deceased were pronounced dead at the scene. A can of airbrush propellant (The Testor Corporation, Rockford, IL) was found in the automobile of the deceased.

Postmortem Findings

The examination consisted of external examination and the collection of biological fluids including blood and urine from the driver and blood from the passenger for toxicological analyses. The immediate causes of death were determined to be hinge fracture of the base of the skull for the driver and atlanto-occipital fracture with transection of the brain stem for the passenger. The manner of death was reported to be accidental.

Toxicological Analyses

Toxicological analyses were conducted on the blood and urine from the deceased driver(A) and the blood from the deceased passenger (B) using a combination of immunoassays (Cedia®, Emit®, and Dri®) and thin-layer chromatography (Toxilab®) for drugs of abuse, and headspace-capillary gas chromatography for volatiles analysis including ethanol and DFE.

Difluoroethane Analysis

A methanolic stock standard was prepared using DFE (Aldrich Chemical Co., 98%+). Methanol (HPLC grade), 2 mL, was added to a 5-mL vial which was then sealed with a teflon cap and weighed.

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TABLE 1—*Toxicology results.*

Decedent	Specimen	Drug Screen	Ethanol	Difluoroethane
A Driver	Urine	Negative		
	Blood(NaF)		130 mg/L	78 mg/L
B Passenger	Blood(NaF)	Negative	Negative	35 mg/L

DFE from a cylinder was introduced into the vial for 1 min via a needle through the cap. The vial was reweighed and the amount of DFE added calculated by subtraction of the weight before the addition. After gentle mixing for 30 min and sitting at room temperature for 2 h to allow equilibration the partition coefficient of the DFE between the methanol and air above the methanol was calculated using the peak areas of the two components following injection of each fraction into the gas chromatograph. The concentration of this stock standard was calculated using the volumes of the vial and methanol, the partition coefficient, and the weight of DFE added. This stock was used to prepare working standards by addition to 5-mL aliquots of blood. Concentrations of the working standards constituting the calibration curve ranged from 0 to 115 mg/L. A stock of the internal standard was prepared by dilution of 3 mL HPLC grade 1-propanol (HPLC grade) with 20-mL deionized water.

Blood specimens (standards, controls, and decedent samples) were prepared in duplicate by addition of 1-mL sample and .05 mL-stock internal standard into 16 by 100 mm test tubes which were capped immediately with rubber septa. The samples were equilibrated at 37°C for 15 min prior to injection of 0.3-mL headspace vapor into a Hewlett Packard 5890 gas chromatograph equipped with a flame ionization detector. A capillary column from Restek Corp (Bellefonte, PA) RTX-BAC-1 (30 m by 0.32 mm ID, 1.8 micron film thickness) was used. The carrier gas was helium at a septum flow (split) of 2 mL/min and a linear velocity of 70–80 cm/s. The oven temperature was 65°C (isothermal) and both injector and detector temperatures were 200°C. Quantitation was based on a 6-point calibration curve.

Results and Discussion

The results of the analyses performed on blood and urine from decedent A and blood from decedent B are shown in Table 1. Comprehensive drug screen analyses (immunoassay and thin-layer chromatography) of urine from decedent A and blood from decedent B were negative. A low level of ethanol, 130 mg/L, was detected in decedent A. An unidentified peak was observed in the blood of both deceased during the headspace-gas chromatographic analysis for ethanol. This peak was identified as DFE by comparison to a standard and a quantitative procedure developed as described earlier in this report. The DFE concentrations in blood of A and B were 78 and 35 mg/L respectively. The concentrations measured are within the ranges of concentrations of other inhalants reported as shown in Table 2. Interpretation of the data is difficult without knowledge of the extent of use before the time of the accident and the pharmacokinetics and distribution pattern of DFE.

TABLE 2—*Concentrations in blood of solvents/inhalants reported in the literature.*

Solvent/Inhalant	Concentration(s)	Reference
Chlorodifluoromethane	71 mg/L	4
Freon 22(Chlorodifluoromethane)	286 mg/kg	5
Freon 22	538 mg/kg	5
Freon 11(Trichlorofluoromethane)	62.8 mg/kg	6
Chloroform	252 mg/L	7
Chloroform	60 mg/kg	7
Enflurane	130 mg/kg	8
Enflurane	710 mg/L	9
Propane	2.8 mg/L	10
Toluene (n=132)	0.2–70 mg/L	11
1,1,1-trichloroethane (n=66)	0.1–60 mg/L	11
1,1,2-Trichlorotrifluoroethane	2.3 mg/L	12

Based on a literature search, we believe that this is the first report of the quantitation of DFE in biological samples.

References

1. Hansen WB, Rose LA. Recreational use of inhalant drugs by adolescents: a challenge for family physicians. Family Med 1995 June;27(6):383–7.
2. Johnston LD, O'Malley PM, Bachman JG. Prevalence of drug use among 8th, 10th and 12th grade students. In: national survey results on drug use from monitoring the future study. Rockville, MD: National Institute on Drug Abuse, US Dept of Health and Human Services; 1993;1975–92.
3. Litovitz TL, Felberg MA, White S, Klein-Schwartz W. 1995 annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. Am J Emergency Medicine 1996;14(5):487–537.
4. Fitzgerald RL, Fishel BS, Bush LLE. Fatality due to recreational use of chlorodifluoromethane and chloropentafluoroethane. J Forensic Sci 1993;38(2):476–82.
5. Morita M, Miki A, Kazama H, Sakata M. Case report of deaths caused by freon gas. J Forensic Sci 1977;10:253–60.
6. Groppi A, Polettini A, Lunetta P, Achille G, Montagna M. A fatal case of trichlorofluoromethane (freon 11) poisoning. Tissue distribution study by gas chromatography-mass spectrometry. J Forensic Sci 1994;39(3):871–6.
7. Kim NY, Park SW, Suh JK. Two fatal cases of dichloromethane or chloroform poisoning. J Forensic Sci 1996;41(3):527–9.
8. Jacob B, Heller C, Daldrup T, Burrig KF, Barz J, Bonte W. Fatal accidental enflurane intoxication. J Forensic Sci 1989;34(6):1408–12.
9. Walker FB, Morano RA. Fatal recreational inhalation of enflurane. J Forensic Sci 1990;35(1):197–8.
10. Garriott J, Petty CS. Death from inhalant abuse: toxicological and pathological evaluation of 34 cases. Clin Tox 1980;16(3):305–15.
11. Meredith TJ, Ruprah M, Liddle A, Flanagan RJ. Diagnosis and treatment of acute poisoning with volatile substances. Human Tox 1989;8:277–86.
12. McGee MB, Meyer RF, Jejurikar SG. A death resulting from trichlorotrifluoroethane poisoning. J Forensic Sci 1990;35(6):1453–60.

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