Fatality Associated with a Novel Pest Control Technology

Michael A. O'Malley
Dennis Gibbons

April 29, 1991

HS-1607

California Department of Food and Agriculture
Division of Pest Management, Environmental
Protection and Worker Safety;
Worker Health and Safety Branch
1220 N Street, Sacramento, California 95814

Introduction

Use of pesticides to control indoor insects has generated considerable scientific controversy regarding their potential risks.[1,2] The degree of public concern is reflected in the large volume of calls handled by U.S. Poison Control Centers regarding exposures to household pesticides. In 1987, 37,856 such calls were reported by the American Association of Poison Control Centers, based on data collected by 63 participating centers, representing approximately 57% of the U.S. population.[3]

Since 1987 a novel pest control (NPC) system has been registered in California, employing extreme cold, rather than a chemical agent, to kill localized infestations of termites. The first step in NPC application is introduction of a fiberoptic scope into a wall space through a scout hole near the base of the wall to identify a suspected infestation. Once an infested area is located, separate holes are made for injectors which pass liquid nitrogen into the wall through braided metal hoses connected to a large cylinder of compressed gas. As the liquid flows into the wall, a copper wire-thermocouple monitors the wall space temperature until it drops to 20 degrees below zero (Fahrenheit) for several minutes.

The NPC system is designed for treatment of wall spaces in structures built with standard construction techniques - i.e. frame construction with 2" x 4" studs spaced at 16" intervals, covered by wall panels made of composite material known colloquially as "sheet rock" or "dry wall". Nitrogen injected into this type of confined space may have little opportunity for rapidly escaping into the ambient air and presenting a hazard to the system operator. Additional confinement of the gas also may be provided by insulating material found in exterior walls.

Because of the potential hazard of using liquid nitrogen in enclosed areas, workers handling the NPC system are required to carry continuous reading oxygen monitors, set to go off when the ambient concentration falls below 19.5 per cent. While manipulating the cylinder and lines, they also wear gloves to protect from accidental "cold burns" and face shields to keep drops of liquid out of their eyes.

Case Report

The Worker Health and Safety (WHS) Branch at the California Department of Food and Agriculture (CDFA) was notified December 16, 1989 of the death of a worker employed by NPC systems during an application to an apartment complex in Santa Monica on the morning of December 15. Subsequent investigation revealed that the worker was 27 years old and previously in good health. He was working alone at the time of his death and was found by the elderly woman who occupied the apartment lying in a walk-in closet adjacent to the bathroom wall that was being treated with liquid nitrogen. He could not be revived by paramedics who arrived approximately 20 minutes later.

Autopsy findings

The Los Angeles County Coroner's Office performed an autopsy on the applicator on December 18, 1989. The autopsy did not show any clear cause of death, but did show marked pulmonary congestion (pulmonary edema). The toxicology screen of urine and blood was negative except for the presence of caffeine and salicylates. Additional significant negative findings at autopsy included normal coronary arteries and the absence of other gross cardiac abnormalities. The anatomical structures of the neck and larynx were intact. The diagnosis recorded by the coroner was "asphyxial asphyxia", also known as simple asphyxia.

Materials and Methods

An investigation at the site of the accident was conducted by an industrial hygienist and physician from the California Department of Food and Agriculture's Worker Health Branch. This included inspection of the application site and interview of available witnesses. Records from other emergency response agencies were also reviewed in order to confirm the sequence of events. A separate application site was also visited, in conjunction with NPC officials, to review normal application procedures.

Results

Normal Application Procedures

Prior to visiting the site of the accident normal WHS evaluated normal NPC work procedures at a large condominium complex in Redondo Beach. At this site, an application was being made in an outside wall open living area with open windows both in the wall being treated and in an intersecting wall to provide cross-ventilation. The treated wall was standard frame and drywall construction, but it could not be ascertained whether it contained insulating material. Using a portable oxygen meter carried by one of the workers, no oxygen deficiency (concentration less than 19.5%) was noted anywhere in the apartment, even when the meter was held less than one inch from the nitrogen injection hole. Similar results were obtained with a handheld Draeger tube. During this visit, all workers were found be wearing the required protective equipment.

Observations at the Accident Site

The apartment complex in Santa Monica where the accident occurred was older construction than the condominium site in Redondo Beach, possibly dating from the 1950's. The applicator parked his truck in the alley behind the complex and climbed up to the level of the apartment to be treated using a ladder set in the bed of his truck. Three holes were drilled into the outside wall of the apartment to inject liquid nitrogen. These were located just below the lower sill of the bathroom window, the place where the infestation had been noted. There was possibly another hole for a temperature probe, but this could not be definitely located at the time of the CDFA inspection. After inserting the injectors into the wall, the applicator let the nitrogen begin running. After a time, he went inside the apartment, with the gas still running, apparently to check the progress of the application. His oxygen meter was left on the truck.

Once inside the apartment he entered the bathroom and then went into the adjacent closet. The wall between the closet and the bathroom did not contain the standard arrangement of studs every 16", but was a "false wall", attached to studs either end to allow access to the bathtub plumbing through an access door at the rear of the closet and less than a foot from the outside wall.

The applicator asked the apartment occupant for a flashlight and a screwdriver, but the occupant could only locate a screwdriver. About 10 minutes later the occupant heard a thud inside the closet and found the applicator stretched out inside, unconscious. He was too heavy to drag out of the closet land and she called her son, who lived in the same apartment complex. He arrived at the apartment and called the paramedics, who arrived within a few minutes of receiving the phone call. They found the applicator stretched out in the closet and completely pulseless, with his face near the open access plate. He had a cigarette lighter in his hand, which he had apparently been using in place of a flash light. A subsequent inspection revealed that the large gas cylinder on the truck had emptied completely into the wall space. The injector sites were within a few feet of the access door.

Comment

Pulmonary edema is a non-specific pathologic finding, but is usually found at autopsy in cases of acute asphyxia. Other causes of pulmonary edema at autopsy include cardiac failure, adult respiratory distress syndrome, fresh or salt water drowning, acute mechanical obstruction of the airways from trauma or laryngeal edema, chemical poisoning, and drug overdose, particularly with narcotics.[4,5] Most of these causes were ruled out by the circumstances of death, the age of the victim, the apparent absence of any prior history of medical problems, and the autopsy findings. The possibility of the death being related to drug overdose suggested by the age and sex of the victim and the incidence of drug-related fatalities in Los Angeles County was ruled out by the negative drug screen. The circumstances of the death, in combination with the autopsy findings compatible with acute asphyxia, therefore strongly indicate that the death was secondary to exposure to 100% nitrogen atmosphere.

The hazard of gaseous nitrogen and other gases that cause simple asphyxia is well recognized. In a recent published series of 233 cases of fatal workplace asphyxia investigated by the Occupational Safety and Health Administration (OSHA) between 1984 and 1986, simple asphyxiants accounted for 48 (20.6%) of the total. Nitrogen *per se* accounted for 18 (7.3%) of the total deaths, followed by carbon dioxide (12 cases), methane (10 cases), argon (7 cases), and propane (1 case).[6] Although not specified in the published report, all of the deaths associated with gaseous nitrogen occurred in confined spaces, principally in ships, rail cars, and storage tanks (personal communication, A. Suruda, 1990).

Conclusions

This episode illustrates that the use of a novel pest control technology may be associated with unexpected release of nitrogen into occupied spaces of treated residences. Although nitrogen is not a metabolic poison, it is similar to other relatively inert gases in its ability to cause acute asphyxia. While this novel technology presents an alternative to traditional pest control techniques, it may not be safe to use in occupied structures. Applicators should be able to recognize variations in construction techniques that may allow rapid dissipation of the gas into occupied spaces. Applicators should also work in work in tandem and be adequately trained in cardiopulmonary resuscitation in case of a potential accident.

References

1. Berteau PE, Knaak JB, Mengle DC and Schreider JB: Insecticide absorption from indoor surfaces. In: Wang RG, Franklin CA, Honeycutt RC and Reinert JC, eds. **Biological monitoring for pesticide exposure, ACS Symposium Series 382**. Washington, D.C.: American Chemical Society; 1989: chap 24

2. Ross J, Thongsinthusak T, Fong HR, Margetich S, and Krieger K. Measuring potential dermal transfer of surface pesticide residue generated from indoor fogger use: an interim report. **Chemosphere**. 1990;20:349-360

3. Litovitz TL, Schmitz BF, Matyunas N, and Martin TG. 1987 annual report of the American Association of Poison Control Centers National Data Collection System. **Am J Emer Med**. 1988;6:479-515

4. Peery TM and Miller FN. Pathology, 2nd Ed. Boston, Mass: Little, Brown and Company; 1971:215-216

5. Wilson JD, Braunwald E, Isselbacher KJ, Petersdorf RG, Martin JB, Fauci AS, and Root RK, eds. **Harrison's Prinicples of Internal Medicine, 12th Edition**. New York, New York: McGraw-Hill, Inc; 1991:223-224

6. Suruda A and Agnew J (1989): Deaths from asphyxiation and poisoning at work in the United States 1984-6. **Brit J Ind Med** 46:541-546