Features
Office of Medical Information
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****UT Southwestern toxicologist explains chemical warfare menace

DALLAS--Chemical warfare--the very words are ominous. And the current crisis in the Persian Gulf has transformed them from the stuff of nightmares and B-grade films to a real and present threat.

But what exactly is chemical warfare? What weapons are involved? How do they injure and kill? And what--if any--treatments are effective once a person has been exposed?

The weapons of chemical warfare fall into three main categories, according to Dr. Kathleen Delaney, assistant professor of emergency medicine in the Departments of Surgery and Internal Medicine at The University of Texas Southwestern Medical Center at Dallas. One consists of pulmonary irritants, including chlorine gas, phosgene gas and the oily, nitrogen-based mustard gas that wreaked so much human havoc during World War I. Another is cyanide. Then there are the so-called nerve gases that are organophosphates similar in chemical makeup and action to insecticides but far more powerful.

All can be released into the air as a gas or vapor, and some -- including chlorine and cyanide -- can be dissolved in water.

Some are easier to detect than others. Chlorine and mustard gas are immediately and extremely irritating to mucous membranes. Phosgene

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is not irritating, and its odor of sweet clover is deceptively pleasant. Cyanide's almond odor is detectable by less than half the population. All can be treated, although the damage they do cannot always be reversed.

"Untreated," said Delaney, "they all kill."

Cyanide, which hit the headlines recently when a Florida food processing plant was revealed as the possible source of cyanide believed shipped to Iraq, is a powerful cellular poison that kills by blocking the body's ability to use oxygen, explained Delaney, whose specialty is poisons and toxic substances.

The brain is the primary organ affected clinically by cyanide, followed by the heart.

A simple carbon and nitrogen compound, cyanide is both an essential ingredient and a byproduct of the production of plastics, solvents, enamels, paints, glues, permanent-press fabrics, herbicides, pesticides and fertilizers. Its affinity for metals has led to its widespread use in extraction of gold from ore, metal polishing and electroplating. It is contained in tobacco smoke and occurs naturally in high concentrations in certain plants and fruit pits.

In sufficient concentration cyanide--in the form of hydrogen cyanide gas--kills swiftly, often within 30 seconds. It is the gas the State of California has used for executions.

But if counteracted quickly enough, cyanide's physiological damage is also the most completely reversible, Delaney said. Treatment consists of inhaled amyl nitrite, followed by intravenous sodium nitrite and sodium thiosulfate. "If you catch them in time, most recover," the specialist stated.

Unfortunately, if cyanide were used in the Middle East, treatment would be complicated by the fact that amyl nitrite is not very stable in desert heat and the other two antidotes must be injected intravenously and immediately, she added.

Delaney said the organophosphates, or nerve gases, "act in the same way as roach killers" although they are far more powerful. Rapidly absorbed through the skin or inhaled, they cause seizures, coma and paralysis; if death does not follow, nerve damage can be permanent, she said.

Prompt administration of intravenous atropine and pralidoxime can be an effective antidote to ordinary organophosphates, but only the military knows how effective they would be against the far more powerful organophosphates that might be used as chemical weapons, she continued. Nerve gas antidote kits containing atropine and pralidoxime are being supplied to U.S. troops in the Middle East. The problem is that both drugs have to be injected intravenously within minutes after exposure. "The troops aren't going to be able to inject themselves or each other," Delaney said. "It would take medics, a lot of medics who hadn't been exposed themselves."

The pulmonary irritants are among the most treacherous in the chemical warfare arsenal. "They get into the lungs and cause injuries that can be permanent," said Delaney. They can also kill outright, but more slowly than cyanide; death from chlorine, phosgene or mustard gas takes 10 minutes or longer.

There are no known antidotes that can reverse the damage done by the pulmonary irritants. Treatment involves respiratory support, including administration of supplemental oxygen and bronchodilators,

endotracheal intubation and artificial ventilation, therapies that would be difficult to provide to large numbers of exposed troops under battle conditions.

A researcher at the Southwest Foundation for Biomedical Research in San Antonio, part of a research consortium with The University of Texas campuses there, is working on an antibody-based vaccine that he says could protect troops against both chemical and biological weapons. But Dr. Tran Chanh said he doesn't anticipate the vaccine's being ready for military use for at least five years.

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NOTE: The University of Texas Southwestern Medical Center at Dallas comprises Southwestern Medical School, Southwestern Graduate School of Biomedical Sciences and Southwestern Allied Health Sciences School.