

TOXALERT



MARYLAND POISON CENTER

February, 2002

Volume 19, Issue 1

Chemical Warfare Agents

Jean McGrath, PharmD
Clinical Toxicology Fellow
Maryland Poison Center

Nerve agents inhibit acetylcholinesterase. The time to onset of symptoms depends on the route of exposure.

The events of September 11, 2001 have brought terror to our doorstep and an increased concern over biological and chemical agents. Physicians, nurses, pharmacists and pre-hospital providers will be at the front line treating affected patients. Due to recent events, there has been much focus on biological agents; however, chemical warfare agents are as much of a threat.

There are 5 main classes of chemical terrorism agents: nerve agents, vesicants, cyanides, pulmonary irritants and riot control agents. They each have different clinical presentations and treatments. These agents have various other names, which can some-

times make identification difficult.

Nerve Agents

First developed in Germany in the 1930's for military use, nerve agents inhibit the enzyme acetylcholinesterase. The clinical effects are miosis, rhinorrhea, bronchoconstriction, wheezing, nausea, vomiting, diarrhea, fasciculations, convulsions, apnea and coma. Onset of symptoms is variable depending on whether the route of exposure is inhalation, ingestion or through skin and mucous membranes. An inhalation exposure can produce effects within seconds. Symptoms can occur within 1 minute to 30 minutes in a dermal exposure or be delayed for as long as 18 hours. The site of exposure and environmental temperatures are also important.²

One of the most important treatments is to remove the patient from the source of the exposure. Goals of decontamination are to prevent the absorption of the toxin in the victim and prevent secondary exposure to health care providers. Dermal exposure to liquid nerve agents require formalized and methodical decontamination in the field. Nerve agents are readily hydrolyzed by alkaline solutions, which explains why sodium hypochlorite 0.05% and soap are effective skin decontaminants. Health care providers must wear personal protective equipment when performing their duties.² Pulmonary exposures to nerve gas vapors do not need decontamination. Previously

CHEMICAL WARFARE AGENTS

CLASS	NAMES
Nerve Agents	Tabun (GA) VX Sarin (GB) Soman (GD) Cyclosarin (GF)
Vesicants	Lewisite (L) Sulfur Mustard (mustard gas) Phosgene oxide (CX)
Cyanides	Hydrogen Cyanide (AC) Cyanogen chloride (CK)
Pulmonary Agents	Phosgene (CG)
Riot Control Agents	CN (Mace) CS CR

**Adapted from Proceedings of the Advanced HAZMAT Life Support Training Conference¹*

Chemical Warfare Agents (continued)

reported terrorist episodes like the Tokyo subway incident have not resulted in cases of secondary contamination of health care providers.

The administration of antidotes is also an essential component of the treatment paradigm. Atropine and pralidoxime are the two primary antidotes for nerve gas exposure. Atropine is a competitive antagonist at muscarinic receptors but does not have any effect on nicotinic receptors. It does not regenerate acetylcholinesterase. In severe nerve gas exposures, 6 mg atropine should be administered IV and then 2 mg IV or IM every 5 to 10 minutes until ventilation is easy and bronchial secretions have dried up. Total doses of 20 mg are not unusual.³ Pralidoxime (2-PAM) is an oxamine that regenerates acetylcholinesterase, allowing the cholinesterase to metabolize acetylcholine. It must be administered early as the nerve agent's effect on acetylcholinesterase becomes irreversible over time.⁴

Vesicants

Mustard gas is the most well known agent of the vesicant group. First used in World War I as a chemical weapon, its most recent wartime use was during the Iran-Iraq conflict in the 1980's. It is a persistent agent, and under the right conditions, long term contamination of the ground can occur.⁴ It is highly lipophilic and penetrates mucosal surfaces easily.² The organs most commonly affected are the skin, eyes, respiratory tract and sometimes the gastrointestinal tract.² Severity and duration of symptoms are proportional to the concentration of the agent and duration of exposure.

Mustard gas has a garlic odor, but after prolonged exposure it may be undetected. Initial reddening of the eyes, conjunctivitis, blistering and severe skin burns can be seen. The hallmark of sulfur mustard exposure is the occurrence of a latent asymptomatic period until hours post exposure. Unless there is a huge exposure the patient can remain symptom free for hours after contact. Treatment is essentially symptomatic and supportive with

no specific treatment recommendations. Early decontamination is the only effective means of preventing damage from mustard gas. The health care professional should wear protective clothing when treating these patients.⁴

Cyanides

The cyanide group consists of two agents: hydrogen cyanide (HCN) and cyanogen chloride. HCN smells like bitter almonds; however, not everyone can smell it. HCN's mechanism of toxicity is inhibition of cytochrome oxidase, thereby interfering with aerobic respiration. Onset of action is extremely rapid with hyperventilation being one of the first signs. This is followed by a loss of consciousness, convulsions and death due to respiratory or cardiac arrest.

The primary treatment is to remove the patient from the source of the exposure. The next step is the use of the cyanide antidote kit, which includes amyl nitrite, sodium thiosulfate and sodium nitrite. These items are also available as individual products that are often stocked in the hospital pharmacy. Many patients can survive an acute cyanide exposure if ventilation and circulation are supported.

Pulmonary Agents

Phosgene is a pulmonary agent that was developed as a chemical weapon by the Germans for use in World War I. It is a colorless gas, which smells like fresh cut hay. It is not readily absorbed through the skin but has considerable toxicity via inhalation. Initial symptoms include eye irritation, lacrimation, coughing and tightness in the chest.⁴ There is sometimes a latent period before the onset of more serious symptoms. Pulmonary edema develops along with a return of some of the initial symptoms of coughing and shortness of breath. There is no specific antidote for treatment of a phosgene exposure. In addition to symptomatic and supportive care, supplemental oxygen and steroids are useful in managing these patients.

A latent period without symptoms is the hallmark of mustard gas exposure.

Phosgene is a pulmonary irritant that can produce pulmonary edema when inhaled.

Chemical Warfare Agents (continued)

Riot Control Agents

Riot control agents are used to incapacitate, not to kill or injure.⁴ They are also referred to as lacrimators, incapacitating agents, tear gas and mace.² There are two main agents in this class: CN (chloracetophenone) and CS (ortho-chlorobenzylidene malononitrile). Clinical effects of these agents include conjunctivitis, contact dermatitis, blisters and tightness in the chest. Treatment is usually prolonged ocular irrigation as well as thorough irrigation of the skin.⁴ These agents are unlikely to cause fatalities.²

Emergency room physicians, staff and pre-hospital providers must be on a heightened state of alert due to recent events. Large numbers of patients presenting to the emergency department with similar symptoms should be questioned carefully for possible chemical or biological exposure. Websites that contain up-to-date information include the CDC (<http://www.cdc.gov/>) and USAMRID (<http://www.vnh.org/BIOCASU/toc.html>).

References:

1. Walter FG, editor. Proceedings of the Advanced HAZMAT Life Support Training Conference; Jan. 2001, Tucson, Arizona.
2. Somani SM, editor. Chemical warfare agents. San Diego, CA: Academic Press, Inc.; 1992.
3. Prevention and treatment of injury from chemical warfare agents. The Medical Letter. Vol.44, Issue 1121; January 7, 2002.
4. Marrs TC, Maynard RL, Sidell FR. Chemical warfare agents: Toxicology and treatment. Chichester, England: John Wiley & Sons Ltd.; 1996.
5. Sidell FR. Nerve Agents. In: Textbook of military medicine: medical aspects of chemical and biological warfare. Zajtchuk R, Bellamy RF, editors. Washington D.C.: Office of the Surgeon General; 1997. 5. p. 129-179.

TOXNOTES: Cyanoacrylates (Super Glue)

A mother accidentally put super glue instead of eye drops in the eye of her 2 year old daughter and her eyelids are now glued together. How toxic is super glue?

Super glues contain cyanoacrylates and produce little toxicity other than rapid adhesion to adjacent surfaces when exposed to air. Eye exposure rapidly seals eyelids together. Corneal abrasions due to mechanical irritation by the hardened glue, loss of lashes, eyelid skin excoriation, or conjunctival inflammation may occur. Treatment of eye exposure begins with immediate irrigation with water or saline. Simple protection with a dry gauze patch will usually suffice, with spontaneous resolution of eyelid adhesion occurring in 1-4 days. Gauze soaked in mineral oil, ophthalmic antibiotic ointments, and tap water may speed this process. Solvents may be used as a LAST RESORT ONLY. Occasionally surgical separation is required.

With ingestion, cyanoacrylates polymerize so rapidly that little, if any, of the monomer will pass beyond the oropharynx without polymerization, making pharyngeal or esophageal adhesions unlikely. The glue adheres to the mouth and tongue producing a grayish-white plaque that may be left alone to wear off.

Super glue on the skin results in little more than adhesion of surfaces. Application of acetone and/or prolonged soaking in warm soapy water, mineral oil, vegetable oil, petroleum jelly or ethanol-water mixtures may result in sufficient softening of the bond to separate tissue surfaces. This may take several hours to accomplish. Rarely, surgical separation is required.



Riot control agents are also known as lacrimators, incapacitating agents, tear gas and mace.

Maryland Poison Center
University of Maryland at Baltimore
School of Pharmacy
20 N Pine St
Baltimore, MD 21201

Bulk Rate
U. S. Postage
PAID
Permit No. 6735
Baltimore, MD



1-800-222-1222

TOXALERT

Poison Prevention Week: March 17-23, 2002

It's that time again! National Poison Prevention Week is right around the corner. Once again, the Maryland Poison Center is making available materials and posters for anyone who wishes to promote poison prevention. Contact Angel Bivens, Education Coordinator, at 410-706-2151 for more information about receiving materials.

**Same Great Service, New Nationwide Number:
1-800-222-1222**

The **Maryland Poison Center** has a new emergency telephone number. The concept is quite simple: calling this new nationwide poison center number anywhere in the United States will connect you to the regional poison center assigned to that calling area. Callers in Maryland, with the exception of Prince George's and Montgomery County, will reach the **Maryland Poison Center**. (Prince George's and Montgomery County callers will be connected to the National Capitol Poison Center in Washington D.C.). You will be hearing more about this new number as the national campaign to publicize it kicks off on January 30, 2002. To obtain telephone stickers with the new number for your home, workplace or community, call 410-706-2151.



***New Maryland
Poison
Center
emergency
telephone
number:***

***1-800-222-
1222***