AMERICAN COLLEGE OF EMERGENCY PHYSICIANS
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When Terrorism Strikes Your Community Will You Be Prepared?

Much of the world has been affected by acts of terrorism and valuable medical information has been learned from these unfortunate incidents of violence. The proper emergency medical response to terrorism requires an understanding of the various types of terrorist acts and resulting patient injuries. Expert faculty will discuss the important issues you must be aware of when developing a plan to handle a terrorist attack including aspects of chemical warfare.

- List the important issues to consider when developing a plan to handle a terrorist attack.
- Identify the resources needed to deal with an emergency medical response to terrorism.
- Explain the mechanism or mechanisms of "nerve gas" and how to treat victims of chemical warfare.

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**Principal - Disaster Planning International*

FACULTY

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When Terrorism Strikes Your Community: Will You Be Prepared?

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I. Course Description

A. Much of the world has been effected by acts of terrorism and valuable medical information has been learned from these unfortunate incidents of violence. A key lesson to the proper emergency medical response to terrorism requires an understanding of the various types of terrorist acts and resulting patient injuries

B. Important issues must be made aware and understood prior to developing a plan to handle a terrorist attack, including special aspects of chemical warfare.

II. Objectives

A. At the conclusion of the course, participants will be able to:
1. List important issues to consider when developing a plan to handle a terrorist attack.
2. Identify the resources needed to deal with emergency medical response to terrorism.
3. Explain the mechanism(s) of "nerve gas" and how to treat victims of chemical warfare.

B. Participants will be given the opportunity to ask questions and discuss implications of the information presented, if time permits.

III. Course Outline

A. Introduction

1. **The New Reality** - Terrorism represents a profound threat to our communities. The end of the Cold War and the success of the US military in the Persian Gulf War have made the threat of total annihilation from thermonuclear war less likely. Terrorists, whether representing foreign governments, religious fervor, or individual anger, have the capacity to harm our cities with explosives and weapons of mass destruction.

2. **Weapons of Mass Destruction (WMD)** – Over 20 countries are currently seeking the technology necessary to acquire Weapons of Mass Destruction (nuclear, biological, chemical - NBC). Some of these weapons (chemical and biological) are relatively cheap, easy to use and transport. Since many of these agents (chemical and radiological) have dual use, identifying them as weapons precursors becomes very difficult.

3. **WMD are weapons of the weak**. Because of the United States conventional military superiority, WMD become the only hope for smaller countries or terrorists ("the great equalizer"). The US policy of deterrence ("second strike capability"), which was dominant during the Cold War, is less effective when it comes to potential terrorist attacks. Retaliation requires knowledge of who launched the attack and the address at which they reside. Two pieces of information not readily available after a terrorist attack.

4. **Most Likely Credible Event** – Explosives, followed by explosives combined with chemicals or radiological agents, chemicals, radioactive materials, biologics, nuclear explosive attempt, and nuclear fission explosion.

5. **Most Worrisome Credible Events** – Compared to chemical and nuclear, biological weapons combine maximum destructiveness and easy availability. Nuclear arms have great killing capacity but are more difficult to acquire. Chemical weapons, on the other hand, are relatively easy to get but lack such killing capacity (because of the volume of agent required).

B. NBC Terrorism

1. **Similarities of NBC Terrorism and Hazardous Materials (HazMat) Accidents.**
   a) Both are instantaneous events that may involve large segments of the community.
   b) Personal protective equipment (PPE) is necessary to reduce personal injury.

2. **Unique Features of an NBC Terrorist Attack**
   a) NBC has the potential for mass casualties.
   b) Psychogenic casualties predominate.

c) Responding personnel are at risk for personal injury.
d) It is a criminal event with a need for evidence preservation.
e) EMS and. hospitals may become overwhelmed

C. Chemical Weapons

1. **Military verses Terrorist Use of Chemical Weapons**
   a) WWI, Iraq/Iran War
   b) Aum Shinrikyo (Matsumoto, Tokyo Subway System)

2. **Nerve Agents -** Nerve agents are extremely potent pesticides (organophosphates) that were chosen for use in warfare because of their toxicity. These agents work by interfering with normal nerve conduction throughout the body, thereby disrupting the way nerves communicate with other nerves, muscles, glands, and organs. As a result, these end organs become over stimulated until they ultimately become fatigued and nonfunctional.

   a) **Properties** - Nerve agents are liquid under temperate conditions, but when dispersed, the more volatile (vapor-prone) agents (e.g., Sarin) constitute primarily an inhalation hazard. Other nerve agents (e.g., VX) are not very volatile and therefore persist longer in the environment when released, constituting primarily a liquid skin exposure hazard. These agents are colorless, tasteless, and lack any reliable warning properties.

   b) **Mechanism of Action** - Nerve agents work by inhibiting the enzyme cholinesterase throughout the body. This enzyme is responsible for breaking down the neurotransmitter acetylcholine (ACh). Failure to break down ACh causes this neurotransmitter to accumulate and over stimulate various end organs (i.e., lungs, muscles, sweat glands, etc.) resulting in a variety of toxic signs and symptoms.

   ACh is released from nerve endings at both muscarinic and nicotinic receptor sites. Muscarinic sites are those receptors innervated by post-ganglionic parasympathetic fibers that are located on salivary and lacrimal glands; smooth muscles surrounding lung bronchioles, blood vessels, pupils, and the gut; and glands of the respiratory and gastrointestinal tracts. These muscarinic receptors are sensitive to the drug atropine.

Nicotinic sites are located on skeletal muscles and ganglia (nerve groups) of the sympathetic nervous system and are resistant to the effects of atropine.

Nerve agents are toxic because they permanently bind to the active sites of cholinesterase, rendering this enzyme inactive and therefore unable to breakdown the ACh neurotransmitter. Because of this binding, acetylcholine continually stimulates the end organ until the process becomes either spent or fatigued. As a result, nerve agent victims develop various signs and symptoms from over stimulation, including: muscle twitching (nicotinic effects), increased salivation (secretions), lacrimation (tearing), emesis (vomiting), miosis (pupil constriction), and shortness of breath (all muscarinic effects).

c) **Signs & Symptoms of Exposure** – The severity of the signs and symptoms of nerve agent exposures depend on the route, duration, and amount of the exposure. The clinical signs and symptoms of nerve agent toxicity are best remembered by the acronym SLUDGE BW (Salivation, Lacrimation, Urination, Diarrhea, Gastric Distress, Emesis, Bronchorrhea, and Weakness).

1. **Vapor Exposure** - Terrorist nerve agent releases destined to impact large numbers of people will typically occur from a vapor exposure. The effects from a vapor exposure are usually realized within seconds to minutes after the exposure ceases. Mild exposures affect primarily the eyes, nose, and lungs. Symptoms include miosis (pupil constriction), conjunctiva injection (red eye), pain behind the eyes, and blurry vision; rhinorrhea (runny nose) and/or excessive salivation; chest tightness with minimal bronchorrhea (lung secretions).

   With higher levels of exposure, clinical signs and symptoms develop in organ systems not in direct contact with the nerve agent vapor. Moderate nerve agent intoxication includes the following signs and symptoms: increasing shortness of breath (with cough, wheezing, and bronchorrhea); muscle weakness followed by fasciculations or twitching of large muscle groups; nausea, vomiting, and/or diarrhea.

Severe signs and symptoms are those which involve the central nervous system and multiple other organ systems. Severe nerve agent intoxication includes the following signs and symptoms: loss of consciousness (within seconds); severe respiratory distress; seizures (within several minutes); flaccid muscle paralysis; and apnea (cessation of breathing).

2. **Liquid Exposure** – Symptoms from skin exposure are slower to develop and reach their peak effect within minutes to hours (usually by 18 hours). Victims with mild skin exposures present initially with signs of localized sweating and fine muscle fiber fasciculations (twitching) at the exposure site only. More moderate exposures result in signs and symptoms away from the initial site of contamination, and include: nausea, vomiting, and/or diarrhea; headache; weakness followed by generalized muscle fasciculations. Severe intoxication results in immediate loss of consciousness, seizures, paralysis, and apnea. Miosis may or may not be seen in liquid skin exposures.

d) **Treatment** – The treatment of nerve agent exposure and/or contamination is self-protection first, followed by removal of the victim from the exposure, maintaining an airway and ventilation, administering antidote therapy, and providing supportive care. These steps should be followed by all emergency providers at every level of care during any hazardous materials incident. Self-protection includes wearing appropriate personal protective equipment (chemical protective suits, boots, gloves, face protection and respirator), unless a vapor-only exposure history is confirmed and the patient's clothing has been removed and doubled bagged prior to providing care. The priorities of emergency care should be based on traditional preferences established for advanced cardiac life support (ACLS) and advance trauma life support (ATLS). This includes the ABC's (airway, breathing, circulation). Antidote therapy for nerve agent exposures includes atropine and pralidoxime (2-Pam or Protopam®).

1. Atropine is an anticholinergic compound that antagonizes and competes with the persistent ACh effect at muscarinic sites. Atropine will reverse rhinorrhea, salivation, lacrimation, sweating, bronchoconstriction, bronchorrhea, nausea,

vomiting, and diarrhea.

2. Pralidoxime actually displaces the nerve agent from the cholinesterase enzyme, allowing the enzyme to become active again, reversing some of the nicotinic effects (i.e., muscle fasciculations, twitching, and fatigue). This drug (Pralidoxime or 2-Pam) must be given within six hours of a Sarin (GB) and sixty hours of a VX exposure to prevent a permanent binding between the nerve agent and the cholinesterase enzyme. This binding process is called aging.

    - Atropine can be given to a patient intravenously (i.v.), intramuscularly (IM), or via an endotracheal tube in 1 - 2 milligram (mg) incremental doses and titrated to the severity of the patient's signs and symptoms. Pralidoxime is given either i.v. (1 gram in 250 cc of D5W over 15 - 20 minutes and repeated two times at hourly intervals) or IM (600 mg/dose to a maximum dose of 1800 mg.) For children, the dose of atropine is 0.02mg/kg and 2-Pam dose is 20mg/kg.

    - Atropine and 2-Pam are conveniently administered by using an autoinjector. This is a spring-loaded syringe and needle assembly that allows for quick medication delivery. These autoinjectors are part of the Mark 1 Kit and may be available through the military or commercial purchase. They include a 2 mg atropine autoinjector and a 600 mg 2-Pam autoinjector.

3. Diazepam (Valium) is an anticonvulsant that is used to treat seizures or reduce their risk of occurrence. It is also used to prevent central nervous system injuries. Diazepam should be considered in victims who are unconscious, having convulsions, severely intoxicated from the nerve agent exposure, or have received both atropine and 2-Pam. The initial dose is 2-5 mg i.v. or 10 mg IM.

e) **Triage** - Triage of nerve agent exposure casualties at the hospital should be based on the signs and symptoms of the exposure and the availability of resources. From the nerve agent experience in Japan we learned that most exposure victims only required observation (i.e., no antidote therapy). Victims closest to the nerve agent release receive the largest dose and typically

die instantly unless airway management and antidote therapy are provided immediately by pre-hospital personnel.

Victims arriving to the hospital that are able to "walk and talk" typically only have mild to moderate vapor exposures. These "non-urgent" individuals will comprise the largest percentage of victims seeking care, requiring little more than observation and occasional antidote administration. In a large-scale terrorist event with numerous victims, these "walking wounded" will arrive first, quickly overwhelming the hospital's capabilities. Under most circumstances these individuals should be triaged immediately to a less urgent area. Ideally, having a bus available to transport these victims to a less congested area (i.e. a school or outlying hospital) is preferred as long as the bus is staffed by personnel trained and equipped to administer the appropriate antidotes.

Casualties that are able to talk, but are unable to walk (muscle weakness), or are having severe respiratory distress are triaged as the highest priority for care. These individuals require airway management and immediate administration of antidotes (6mg of atropine and 1-2 grams of 2-Pam) since adequate therapy helps ensure a good prognosis. Patients still breathing and conscious will survive with appropriate early therapy. Even victims who have stopped breathing but have a palpable pulse may still survive with immediate airway management and antidote therapy.

Victims who have received antidote therapy and whose symptoms have improved may be triaged to a less congested area for continual observation.

3. **Blistering Agents (Vesicants)**

a) **Properties** – Blistering agents are primarily a liquid (and vapor) hazard. Damage occurs within one to two minutes of contact, but the clinical manifestations may be delayed (hours for sulfur mustard, instantaneous with lewisite).

b) **Characteristics** – Exact mechanism of injury is unknown. These agents are thought to alkylate cell protein and DNA leading to cell death.

c) **Treatment** – Immediate decontamination to prevent cross-contamination, airway management, and supportive care.

4. **Cyanide**
   a) **Toxicity** – Binds to iron (ferrous – Fe3+) in the cytochrome oxidase of the mitochondria preventing the cell from using oxygen. At low concentrations victims become anxious, hyperventilate, develop headaches, dizziness, and vomiting. *Symptoms resolve when the victim is removed from the source.* At high concentrations the victim becomes anxious and hyperventilates within 15 seconds; develops seizures within 30 seconds; stops breathing within 3-5 minutes, and becomes asystolic within 6-10 minutes.

   b) **Treatment** – Remove from the area and discard clothing; administer oxygen, and if unconscious or not improving give the cyanide antidote kit (amyl nitrite, sodium nitrite, sodium thiosulfate) and provide supplemental oxygen along with airway management.

5. **Choking Agents – Phosgene, Ammonia, and Chlorine** – these agents are all readily available and can potentially cause (acute or delayed) life-threatening injury after inhalation. All of these agents react with water (especially in the eyes and upper airway) to form a corrosive. Treatment is supportive and includes airway management, decontamination, eye irrigation, and bronchodilators.

6. **Riot Control Agents** – both irritating agents and lacrimators are readily available and work primarily on the eyes, nose, mouth, and lungs. Their clinical effects are immediate and may last up to 30 minutes. Medical management is purely supportive (decontamination may be required).

D. Role of Hospitals

1. **Primary Providers of Medical Care to Disaster Victims –** While fire, HazMat, EMS, law enforcement, and emergency management agencies prepare to meet the threat of a terrorist attack, all victims will eventually seek care from the local hospital system. Hospitals provide the majority of first aid, decontamination, and antidote therapy to disaster victims. Hospital disaster plans must have the inherent capacity for rapid activation, because patients often arrive unannounced at the facility.

2. **Patient (victim) Decontamination** – Decontamination is the

physical process of removing harmful substances from personnel, equipment, and supplies. It should be performed whenever there is a risk of secondary exposure. *Every hospital should have the capacity to safely assess, decontaminate, and treat at least one patient exposed to a biologic, chemical, or radioactive substance.* Hospitals should also perform a thorough assessment of their current capabilities and rectify any deficiencies. This assessment should include:

a) The current level of training provided to emergency department personnel (and other support staff).

b) The availability of personal protective equipment (PPE).

c) The availability of decontamination equipment.

d) Development of a Policies and Procedures Manual that addresses the decontamination operation.

E. Summary

1. Training will bring order to a mass casualty (terrorist) incident.

2. Training must include:
   a) Personal protective equipment (PPE).
   b) Patient decontamination.
   c) Antidote therapy.
   d) Hands-on and tabletop exercises.

3. Maintain proper antidote supplies.

4. Ensure decontamination capability.

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