Responding to the Threat of Weapons of Mass Destruction Parts I and II

A continuing education activity offered by the
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Health Science Center at Fort Worth
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LEARNING OBJECTIVES

Those completing this activity will receive information that should allow them to…

- Define terrorism;
- Evaluate hospital preparedness regarding a terrorist attack;
- Discuss federal responses to a terrorist event;
- Differentiate the role of the hospital, physician and the public health department in response to a terrorist attack;
- Review the history of terrorism;
- Define and list the types of chemicals potentially used as terrorist weapons;
- Understand the relevance of the history of nerve gas; and
- Understand the toxicology, clinical aspects and treatment of nerve gas injury.

ESTIMATED TIME TO COMPLETE ACTIVITY

It should take approximately one hour to read this article and complete the exam and evaluation.

DIRECTIONS

Please read this article in its entirety before proceeding to the questions. See sub-heading “How to Receive CME Credit” below for credit information.

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Part I

“Soldiers” Against Terrorism

Introduction

In response to the deaths of more than 3,000 Americans as a result of the events on Sept. 11, 2001, our nation is improving our military and public health infrastructure. A heightened sense of patriotism has created a stronger sense of purpose. Physicians are aware that they need to be prepared to provide medical care for the victims of terrorist acts. This series is designed to inform health care professionals of terrorist threats determined by military and government sources.

What is Terrorism?

The Federal Emergency Management Agency (FEMA) defines terrorism as the use of force or violence against people or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Terrorists often use threats to create fear among the public, to try to convince citizens that their government is powerless to prevent terrorism, and to get immediate publicity for their causes.

The Federal Bureau of Investigation has two categories of terrorism in the United States: domestic terrorism and international terrorism.

Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States or whose activities transcend national boundaries.

Doctors are “soldiers”

As our nation wages its war on terrorism, the threat of future terrorist acts against the United States continues. By now, physicians and other health care workers must realize that they too are “soldiers” in this two-front war. They must be prepared to respond appropriately and quickly to public health threats. Their weapons are compassion, knowledge and responsiveness.

The usual medical curriculum must be expanded to better understand the tools of terrorism and their ramifications. Our professional organizations and CME sources need to provide accredited, factual information on nuclear, biological and chemical warfare.

Hospitals must ensure that their emergency facilities are properly equipped to handle Level A or B (Environmental Protection Agency classification) emergencies.[1] More emergency drills will have to take place at hospitals as well as in the community. This will have to be

properly coordinated. Methods of disaster communication and delegation of responsibility at a local, state and federal level must be dynamically explored and improved. As physicians, we cannot assume that a response system is already in place. In some hospitals there is little or no capability to handle Level A or B incidents. Check with your facility. How many personal protection suits and respirators do they have? What EPA disaster category level are they capable of handling? How many cases can they decontaminate per hour? What triage system do they utilize and how efficient is it? Who is responsible? Who is their backup? The entire staff needs to be cooperative in case of an emergency and know their role and duties prior to an actual terrorist attack.

In the office setting, two things are vital: knowledge of the chemical and biological agents that may be used by terrorists so that they can be recognized early, and prompt reporting of any suspicious medical condition to the local health department.

There is evidence that some physicians are not adequately reporting diseases to public health authorities as required by the state. This must change. After all, terrorists can also utilize some common agents such as salmonella, and E. Coli to promote intimidation or illness. In 1984, a religious sect (Rajneeschee) added salmonella to salad bars in various restaurants of Dalles, Ore., in order to influence the outcome of an election. More than 750 townspeople became ill. Only a centralized center such as the public health department, with expertise in risk assessment and epidemiology, can determine the relevance of such an incident.

Not all physicians and allied health care professionals have access to the Internet and some in rural settings are educationally isolated. In these situations, local and state health departments and medical societies must play an important role to educate health professionals in outlying areas.

Public health agencies have traditionally been more involved with biological agents and more recently have had to adjust their response to chemical and nuclear agents.

The Federal Response: More Work to be Done

In recent years, the federal government has increased funding to the public health sector with bioterrorism preparedness in mind. [2] In the event of a major terrorist nuclear, biologic or chemical (NBC) attack, federal government agencies will play an important role in investigating and resolving the incident. This includes the Centers for Disease Control and Prevention, The Department of Defense, the Environmental Protection Agency, the Federal Emergency Management Agency and the Federal Bureau of Investigation. While these organizations maintain the highest profile, there are approximately 40 federal agencies

with some responsibility in responding to a terrorist attack.

After the 1995 Oklahoma City bombing, President Bill Clinton issued a directive that sought to clarify the roles and responsibilities of federal agencies in the event of a nuclear, biological or chemical attack. In 1996, Congress passed the Defense Against Weapons of Mass Destruction Act to train and equip state and local emergency services personnel who would be the first to respond to a domestic terrorist incident. But those initiatives have proceeded slowly and have been criticized by government investigators and outside specialists as woefully inadequate.

There are still problems to be addressed in regard to response and coordination at the highest levels of government. According to Rebecca Hershmann and W. Seth Carus with the Center for Counterproliferation Research at the National Defense University, The Department of Defense should:

- "Integrate consequence management requirements to recognize similar but competing missions for the same resources and units.
- Examine consequence management responses under more stressful scenarios, including multiple events in geographically dispersed areas against varied targets, or terrorist attacks in conjunction with a major theater war.
- Promote greater alignment of DOD responsibilities and requirements in consequence management (usually underestimated), and available assets or capabilities (usually overestimated).
- Develop appropriate organizational structures that provide sufficient civilian and military oversight and provide a mechanism to deconflict competing demands for limited assets. These structures should focus on function, priority, and the availability of alternatives.
- Recognize the significant force structure and strategy implications of large-scale DOD participation in domestic consequence management and address these implications in the next quadrennial defense review.
- Reduce DOD consequence management operational requirements by helping allies and coalition partners, as well as state and local communities, improve their capabilities to conduct consequence management." [3]

According to a report posted on the Chemical and Biological Weapons Nonproliferation Project at the Henry T. Stimson Center Web site at http://www.stimson.org/cbw/?sn=cb20011221154, "The key to improving federal terrorism prevention and response also lies on Capitol Hill. There, the shock of Sept. 11 evoked steely rhetoric and choruses of 'God Bless America.' Unfortunately, that spirit may soon give way to the

fractured jurisdictions and pet projects that have seriously hindered Congress' ability to help fashion federal structures and programs on terrorism. Congressional oversight is scattered across more than a dozen committees. This bodes ill for coherence and cost-effectiveness. With consolidation of oversight responsibilities in order, congressional participation in a national summit is of paramount importance." [4]

This was exemplified in May 2000 when top officials in the federal government conducted a $3 million exercise simulating a terrorist attack on three cities: Denver, Washington D.C. and Portsmouth, N. H. This exercise was designated TOPOFF and demonstrated command difficulties, problems with allocating resources and crises that a disease epidemic would cause in the civilian health care sector. [5]

Further deficiencies were identified and recommendations were made after a simulated smallpox attack during an exercise called Dark Winter. It was conducted June 22 and 23, 2001, at Andrews Air Force Base. [6]

Progress Being Made

On Sept. 20, 2001, just nine days after the attack, President George W. Bush appointed outgoing Pennsylvania Governor Tom Ridge to the cabinet position as director of the Office of Homeland Security*. His responsibility is to coordinate all agencies involved in this area to permit a more cohesive response. Other efforts have also been made at the federal level to improve flexibility in response and adapt military expertise to civilian needs. The Department of Defense established the Joint Task Force for Civil Support in October 1999. This agency will direct military support to other federal agencies responding to a NBC attack. In addition, the new position of Assistant to the Secretary for Civil Support was established in the Department of the Defense.

The Centers for Disease Control and Prevention is going to take a leadership role in combating terrorism. On July 20, 2001 Department of Health and Human Services Secretary Tommy Thompson appointed Dr. Scott Lilibridge of the CDC as his special advisor to lead the DHHS initiative against bioterrorism. The CDC has prepared a report called *Biologic and Chemical Terrorism; Strategic Plan for Preparedness and Response*. It should serve as a working model to achieve excellence in our future abilities to combat terrorism. [7]

The CDC has provided the National Pharmaceutical Stockpile (NPS) to assist state and local health departments, the health care community and first responders with a two-tier response to a terrorist incident. The first is response within 12 hours to deliver push packages containing pharmaceuticals and medical supplies. The second response is within 36 hours or less and is a Vendor-Managed Inventory, which is customized to the nature of the problem.

The CDC, in cooperation with the National Association of County and

* Homeland Security Office est. 11/2002

City Health Officials (NACCHO), the Association of State and Territorial Health Officials (ASTHO), and other health organizations has developed the Health Alert Network (HAN). [8] The HAN provides:

- High-speed, continuous, secure connection to the Internet, access to public health information, and front-line staff skilled in the use of electronic information and communications technology
- Distance-learning capacity, via satellite- and Web-based technologies, for continuous upgrading of skills in preparedness for bioterrorism and other health threats
- Early warning systems, such as broadcast fax, to alert local, state and federal authorities and the media about urgent health threats and about the necessary prevention and response actions
- Connectivity of local health officials nationwide to instantaneously access and share disease reports, response plans, and CDC diagnostic and treatment guidelines
- Strengthening of local health departments and their links to critical community health organizations, such as hospitals, laboratories, Emergency Medical Systems (EMS), and clinicians that need to form a coordinated public health response to bioterrorism
- The capability for local, state, and federal health authorities to communicate and coordinate rapidly and securely with each other and with law enforcement agencies.

Laboratory testing for biologic agents must be coordinated and accurate. The Laboratory Response Network for Bioterrorism (LRN) is a collaborative effort, involving more than 100 laboratories, which links state and local public health laboratories in an organized network. There are four levels of these laboratories, A through D. The highest level (D) has the highest amount of technical proficiency, containment capability and safety. Thus far Congress and the American people are unified in their desire to eliminate the threat of terrorism. It is required that we keep our focus and gain expertise in fighting an unconventional war on all fronts.

Summary

The John Hopkins Center of Civilian Biodefense Studies has provided an excellent summary with references to help us define our responsibilities as hospitals, physicians and public health officials. [9]

Courtesy: http://www.defenselink.mil/photos/Oct2001/011007-F-6833L-047.html (Department of Defense) B1B bombers taking off for Afghanistan

Part II
Overview of Chemical Warfare:
The Nerve Gases

Introduction

On Sept. 11, 2001, the average citizen in the United States went to bed feeling much less safe than when he had awakened that morning. Terrorists caused massive destruction of property, including the famous World Trade Centers and a portion of the Pentagon. More civilian deaths occurred on that single day than all the terrorists acts ever perpetuated in this country previously. After a period of confusion, denial and insecurity, the mood of this country changed to anger and frustration and finally resilience and resolve. We now understand that a war has been initiated against us and in turn we have declared one against terrorism. It is likely to be a prolonged, unglamorous and dangerous war. In addition to our country conducting a military offensive, it is a war that we are all involved with.

Bioterrorism has no boundaries for race, age or sex. The impact of the terrorist acts on the economy is obvious, but the health of the nation is also suffering. Polls taken after the attack reveal that 52 percent are depressed attributed directly to the Sept. 11 terrorist acts, and 75 percent of Americans believe more attacks will occur. Intelligence sources estimate a higher probability than that, and state that it is not a matter of if, but when, where and with what. [1]

There are over a hundred known terrorist organizations across the world, many with multiple cells. Besides suicide bombing and the use of other explosive methods, some of these organizations have access to chemical and biological weapons (CBW). There is also a threat of nuclear devices. This series was designed to assist the physician in making more appropriate decisions in recognizing and treating these threats and better informing the public and his colleagues.

Taken into perspective the incidence of chemical and biological threats appears to be increasing. Prior to the late 1980s, the FBI investigated about a dozen cases a year of actual or threatened terrorist acts. In 1997, the FBI launched 74 investigations against CBW (chemical and biological warfare) incidents or incident attempts. In 1998, it rose to 181 investigations. Is there a national hysteria about the possibility of chemical and biological attacks and their potential impact on the public? Senior policy consultants and independent scientists performing threat assessments have written that the federal government is looking at this situation from a worst-case scenario with incomplete facts regarding the motivation of the terrorists. The developments that have occurred after Sept. 11 may have changed risk assessment opinions as more intelligence has provided a chilling insight into Usama Bin Laden's network. Perhaps a worst-case scenario is

appropriate for planning and budgeting purposes.

The Center for Nonproliferative Studies at the Monterey Institute of International Studies in California developed a database on 520 global CBW incidents between January 1900 and May 1999. They found that 282 of these were terrorist attacks or threats, and 231 were criminal acts.

Deranged U.S. citizens, zealous religious groups and other internal terrorists such as Timothy McVeigh must be remembered when understanding terrorist acts. Besides the Oklahoma bombing incident, U.S. incidents involving casualties include the 1989 delivery by racial extremists of a package containing a tear-gas bomb to the Atlanta office of the National Association for the Advancement of Colored People, which injured eight; and attacks with butyric acid against abortion clinics in Houston and Florida in 1998, injuring 14 people. [2]

In June 1994, a religious cult in Japan released sarin, a nerve gas, injuring 300 people with seven dead. In March 1995, this same cult, the Aum Shinrikyo, released sarin in three separate subway systems. About 6,000 people sought medical care. Some had mild to moderate nerve gas poisoning, but many did not. There were 12 fatalities. [3]

Chemical Weapons

This series will first address chemical agents, since physicians are more familiar with the use of antibiotics and biologic agents. More casualties

have been caused by the use of various chemical agents for military purposes and terrorist acts than infectious agents. In part one, we will cover the nerve gases because they can kill rapidly. In lower concentrations, these agents can be nonfatal and thus recognized and treated.

Definition

NATO defines a chemical agent as a substance that is intended for military operations to kill, seriously injure or incapacitate people because of its physiological effects. [4]

Types of chemicals utilized in warfare

1. Nerve gases
    a. Non-persistent
    b. Persistent
2. Blister Gases
    a. Mustards
    b. Arsenical Vesicants – Lewisite
    c. Halogenated Oximes
3. Lung Damaging or Choking agents
4. Blood or Cyanogens Agents
5. Incapacitants
    a. CNS Depressants
    b. CNS Stimulants
6. Riot Control Agents

6. Vomiting Agents
7. Smokes, Fuels and Incendiary Materials
8. Flame Materials, Hydrocarbon Fumes and Incendiary Devices
9. Picloram
10. Ricin
11. Tricocethenes (mold derived)

History of Nerve Gases

The earliest attempts to use chemicals as weapons in modern times were during World War I. Canisters of chlorine gas were released into the battlefield, causing massive casualties and demoralization of troops. Wind shifting and temperature changes made the effects unpredictable and sometimes the effect on the deploying forces was worse than on the intended troops. Later, blister gas (Nitrogen Mustard) created an even more devastating impact. Mustard gas was heavier and much more persistent than chlorine, and affected the skin as well as the respiratory system. The gas masks and protective garments of the day did not effectively eliminate the danger of mustard.

Among the many toxins investigated during and after World War I, the nerve gases held the highest promise as effective agents to kill rapidly while leaving the infrastructure intact. They are 15 to 100 times more potent than the gases used during World War I. Nerve gases are not technically difficult to manufacture and the chemicals needed to manufacture them are inexpensive. They are however, difficult to handle and hard to disperse effectively to ensure that large populations are affected.

In December 1936, Gerhard Schrader, head of a research team to discover new insecticides at I. G. Farbinindustrie in Germany, synthesized tabun. One year later, his team synthesized sarin. Potential for military use was recognized early and by 1942, tabun production had begun. Thirty-thousand tons of tabun were placed in shells and bombs between 1942 and 1945. Only a half ton of sarin was produced during this time. There is some evidence that Hitler was advised not to use chemical weapons for fear of massive retribution. More likely, we should remember that in 1918 a young corporal named Adolph Hitler was temporarily blinded by a British gas attack in Flanders and personally experienced the horrors of gassing. The Soviets captured the manufacturing facility and moved it to the Soviet Union, with sarin and tabun production initiated in 1946. Soman was discovered in Germany in 1944. The North Atlantic Treaty Organization designated tabun as GA. Sarin was designated GB and soman was GD. In addition there is a compound termed GF with no common name. Great Britain recently synthesized a toxic product termed VX which is a less volatile liquid and thus more persistent. There is no common name for this compound, which is methylphosphonothioic acid.

After World War II, many developed nations conducted research and stockpiled nerve gases as well as biological agents. More recently, underdeveloped nations have

acquired this technology. There is evidence that tabun was used by Iraq to attack Iran in their war from 1982-1985. It was also used by Iraq on elements of the Kurdish minority in northern Iraq. Even Kurdish extremists used it against a Turkish village.

Several attempts have been made in the United States to use chemical agents against our citizens. The most common chemical agent used in attacks during the last 90 years is cyanide. For example, in 1986, a white supremacist Christian identity group known as the Covenant, the Sword, and the Arm of the Lord sought to overthrow the federal government and hasten the return of the Messiah. They acquired 30 gallons of potassium cyanide to poison urban water supplies, believing that God would direct the poison to kill only the targeted individuals: nonbelievers, Jews, and blacks living in major cities. Before they could act, however, the FBI penetrated the group and arrested its leaders. [5,6,7,8,9,10]

Toxicology

Definitions:

a. Dose: The quantity of the compound received by the subject.
b. LD_{50} the lethal dose $(LD)_{50}$ is the dose that kills 50 percent of the exposed population.
c. ID_{50} is the dose that incapacitates 50 percent of the population.
d. Ct (Concentration time) – is a measure of concentration of an agent per minute. It is expressed as $mg.min.m^3$
e. LCt_{50} is the concentration that kills 50 percent of exposed population per unit of time.

Today's nerve gases are synthetic esters of phosphonic acid and are related to organophosphates, which are used as insecticides and occasionally in medicine. Our current treatment of Alzheimer's disease utilizes a reversible type carbamate organophosphate.

Nerve gases are highly lethal. Sarin is 26 times more deadly than cyanide gas. Less than one drop is fatal. Even more potent, experimental bipolar nerve agents called Novichok agents, were developed by the Soviet Union in the late 1980s and early 1990s. In general, the LCt for nerve agents is 10 to 200 $mg.min/m^5$

Certain nerve impulses require the generation of acetylcholine from their end plates to transverse to the next portion of the nerve and initiate a physiologic response. Acetylcholine is the primary neurotransmitter of the parasympathetic nervous system and is the prime product found in the nerves to the skeletal muscle and the post ganglion parasympathetic nerves. Acetylcholinesterase (AChE), an esterase enzyme with a high affinity to break down by hydrolysis, the esters of choline, is found at the receptor, attached to the red blood cell (true or RBC AChE) or found in the serum (pseudocholinesterace) and rapidly destroys acetylcholine to stop this impulse generation and permit the next impulse to occur. This action occurs by complexing with the

acetylcholine and reactivation at a specific receptor. The reaction is shown as acetylcholine $(CH^3)^3 NCH^2CH^2OCCH^3 = H^2O \rightarrow$ choline $(CH_3)_3 NCH_2 CH^2 OH$ + acetic acid CH^3COOH in the presence of acetylcholinesterace.

In the presence of a nerve agent there is a nearly irreversible combination with AchE. Thus acetylcholine accumulates and produces most of the symptoms seen with these agents. There are other effects of nerve agents such as calcium channel changes. These effects are beyond the scope of this discussion.

Nerve gases can be absorbed through the eyes and mucous membranes. All but VX are poorly absorbed through skin. Ingestion is possible on contaminated food or beverages. Skin cuts or nicks can act as portals for nerve gas absorption. VX is a less volatile product that can penetrate skin, the eye and mucous membrane. It is much more persistent than the G series.

The G series are slightly denser than water and heavier than air so they tend to cling to the ground. In their pure state they are odorless and colorless but often are yellow to brownish when impure. Some smell faintly fruity.

Dispersion of nerve gases is affected by prevailing winds, inversions, temperature, humidity and host characteristics of the subject.

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Clinical Aspects of Nerve Gas Poisoning

The signs and symptoms depend on the Ct (See definitions). Not all cases are fatal, as shown by the Aum Shinrikyo experience. In open spaces it is even more difficult to achieve a high Ct than in a subway system. At a low Ct of 3, (produced by 0.05 mg exposure over 40 minutes) the first thing to detect on physical examination is extreme contraction of the pupil (miosis). Miosis is also the last manifestation to return. Then the ciliary body of the eye is affected resulting in blurred vision, eye pain and frontal headaches. At a Ct of 5, we also see tightness of the chest, rhinorrhea. At a slightly higher Ct, bronchospasm, bronchorrhea and a cough occurs. Not all subjects experience bronchospasm. At a Ct of 15, the RBC acetylcholine levels are depressed about 50 percent from baseline and nausea, vomiting and hypersalivation occurs in addition to the other signs and symptoms mentioned. The excess secretions from the bronchial tree, upper respiratory region, gastrointestinal tract and eye are termed muscarinic effects. In severe but non-fatal cases, the miosis can last 14 days while new acetylcholinesterace regenerates. In milder cases it usually lasts 48 to 72 hours. The headaches can last up to two weeks. In moderately severe cases the

respiratory effects can last for 48 hours. Most non-fatal cases completely recover.

At high concentrations, closer to the site of release the Ct climbs to 40 $mg.min.m_3$. At this level the RBC acetylcholine levels drop to 80 percent below baseline. Weakness, defecation, urination, paralysis and convulsions occur, which may then be followed by respiratory failure. These are termed nicotinic effects. Other nicotininc effects seen are extreme fatigue, muscle twitching, cramps and paralysis of the muscles of respiration, which is the principle mechanism of death. Hypotension and bradycardia are found with this condition though initially hypertension can be found.

Central Nervous System symptoms occur, including: EEG abnormalities, confusion, emotional lability and depression of the central centers for respiration and circulation. Giddiness, tension, anxiety, restlessness, insomnia, tremor, difficulty concentrating, slurred speech and even ataxia can be seen for weeks in some cases.

Death can also occur from anoxia due to airways obstruction. Airways obstruction can be due to laryngospasm, bronchospasm, pharyngeal muscle collapse and/or excessive secretions.

With overwhelming doses, this natural progression of symptoms does not occur. Collapse, convulsions and death from respiratory failure can occur in as little as one minute.

Late effects: Only limited human data is available about nerve gas attacks, but those exposed to mild to moderate doses do not appear to have persisting neurologic or psychological deficits that cannot be attributed to psychiatric factors. However, acute neuropsychiatric effects lasting several weeks can occur with nerve gas exposure. There are no reported cases of delayed polyneuropathy, the intermediate syndrome, muscle necrosis or chronic persisting neuropsychiatric effects, like those sometimes found after certain insecticide poisonings.

Measuring RBC cholinesterase is important in cases of miosis and unexplained illness affecting the neurological, gastrointestinal or respiratory system. Repeated monitoring with this test is required with nerve gas poisoning. If RBC cholinesterase levels are unavailable, plasma pseudochloinesterase measurements are recommended.[11,12]

Treatment

Definitions:
(a) *Pretreatment* – pretreatment is the use of drugs in advance of poisoning designed to increase the efficacy of treatment post-poisoning.

This is different from (b) *Prophylaxis,* which is administered medication in advance of poisoning designed to make post-treatment unnecessary.

For obvious reasons, pretreatment in a civilian population may not be possible prior to an attack and deaths can be both expected and

serve as an indicator of the seriousness of the situation. The use of a NBC suits and a proper respirator are essential in the event of an expected nerve gas attack.

Remember, organophosphate poisonings may also occur from insecticides and not nerve gas attacks, but these are usually isolated cases that involve only a few people. Between 1993 and 1996 there were 6,300 pesticide poisonings reported to the Toxic Exposure Surveillance System – 41 percent involved organophosphates. Though nerve gases have certain things in common with insecticides they are different in other ways. The acute cholinergic crises caused by insecticides lasts for days to weeks, but generally lasts only hours from a nerve gas.

For pretreatment, Carbamates anticholinesterase such as pyridostigmine 30 mg orally every eight hours with food can be used as a pretreament option since these are reversible carbamates. Side effects, predominantly gastrointestinal, are present frequently with this product. But in analyzing the Gulf War veterans who took this program for four to five days, a vast majority felt that that their symptoms were tolerable and they could perform their assigned tasks. Optimal protection is achieved by the third dose. Soman ages rapidly, in other words fixes irreversibly to the AchE, so pretreatment will have limited effect on this product. Carbamylation with pyridostigmine of AchE is about 30 to 40 percent effective.

The treatment methods vary to some extent depending on what manifestations are occurring. These depend upon factors including: whether it is a local or systemic effect, the degree of exposure and any pretreatment provided or personal protection.

For protection, a suitable respirator may alone be sufficient for non-persistent nerve gases such as GA or GB. However, protective NBC (or Level 4) overgarments are recommended for all health care workers since some skin penetration can occur, and initially the type of nerve agent used is unknown. Obviously at a community level, with the exception of emergency providers, policy has yet to be set for protective garments or respirators and this is more applicable to the military and emergency personnel at this time.

The first step for any exposed individual is decontamination. This is especially relevant if a liquid type or heavy droplets of nerve gas are identified. The purpose of decontamination is to rapidly and effectively render harmless or remove poisonous substances both on personnel and equipment. Nerve gases can penetrate rubber, paint and plastic, making them more difficult to decontaminate. Decontamination of a patient lasts 10 to 20 minutes. The Aum Shinrikyo cult incident taught us that hospital workers who treated these victims were not immune from symptoms developed from secondary exposure. Up to 30 percent of health care workers dealing with these victims

suffered mild to moderate symptoms. To reduce this threat, make sure your protective clothing is properly sealed; dispose of contaminated garments in an impermeable bag. Small doses (1 to 3 mg of sarin on the skin) received by a health care worker may not manifest its affects for hours. Nerve agents are moderately soluble in water and very soluble in lipids. They are rapidly inactivated by strong alkalis and chlorinating compounds such as Clorox or bleach powder. In the military a 0.5% hypochlorite solution is used for skin contamination for VX but water may be used for the G series.

If nerve gas is suspected, based on events or examination, it is recommended that 2 mg Atropine IM be given stat, even at the onset of decontamination. Repeat this dosage frequently depending upon the signs and symptoms in response to this treatment. Atropine should be administered until signs of atropinization occur (dry mouth and skin, and heart rate greater than 90 beats per minute.) Miosis will not change from the atropine. The mild atropinization should be provided by atropine sulphate 1 to 2 mg every 0.5 to 4 hours and should continue for at least 24 hours.

The atropine should also be provided concurrently with an oxime such as 2-pyridine aldoxime methyl chloride known as pralidoxime chloride (PAM CL) 1 gram IV every 8 to 12 hours. An alternative method to use PAM is as a continuous IV infusion based on a theoretical plasma concentration of 4 mg per liter. A loading dose of 4.2 mg.kg is utilized by NATO recommendations followed by 2.2 mg.kg.hr infusion rate. PAM serves to relieve the effects of the skeletal neuromuscular blockade. Atropine does not have this action but penetrates the central nervous system far better than PAM. Thus, they complement each other. Convulsions can be treated with IV or IM Diazepam. Basic airways, blood volume and cardiovascular support are obviously vital. Aggressive support including a ventilator may be required. Bronchial secretions may be quite copious and should be suctioned. Tracheotomy or intubation is required in severe cases.

Discussion

The presence of nerve gas can be measured with specialized equipment (ICAM). These include chemical strips (M8 or M9 strips) and Military Fox vehicles (Named after Fuchs as it is a German detection vehicle). Thus far, one would not expect civil authorities to possess these in adequate numbers. It may be recommended for emergency facilities to have M8 strips available, as all suspected nerve gas injury cases should be monitored and screened with some type of instrumentation. In addition, such instrumentation is required to clear the individual after decontamination to go from the contaminated to the clean area over the hotline. All emergency facilities must use a triage, emergency treatment and decontamination protocol with a contaminated area separated from the non-contaminated area. [13,14,15]

Most states mandate that their local health departments, by law, are the agents to respond to a terrorist attack and should be contacted immediately if a biological, radiological or chemical attack is suspected. It is better to be safe than sorry at this time. The local health department acts as an initial triage and risk assessment agent. If all cases are reported properly, then such an agency can attempt to determine if there is a cluster of cases or an isolated incident. Local and state health departments, working with primary care physicians, law authorities and emergency preparedness or management departments, are currently planning methods to: facilitate education of the public and health care provider, as well as interagency communication; improve their response capability to a terrorist by simulation exercises; and improve coordination of the chain of command and on site authority with various agencies including local, military and federal assistance programs. State and local health departments provide early detection, rapid response capacity, and intervention planning. Find the phone number of the Federal Bureau of Investigation, which is also mandated to investigate any terrorist threats and acts, and your local health department and keep these numbers posted. The creation of a communication system not dependent upon phone lines is important. Backup systems include MedNet, Cmed and other emergency management systems networks.

We are still waging our offensive war on terrorism. We must continue to improve our defense capabilities. More federal resources will be required to permit enhanced capability for rapid surveillance and risk assessment, enhanced rapid laboratory testing methods with fast turn-around times, and a consideration for changes in immunization procedures. [16,17]

Summary

Nerve gas attacks may be a part of future terrorist acts as they have been in the past. Nerve gases produce a distinct clinical picture that, with prompt and appropriate recognition and treatment, permits a generally favorable prognosis on those that survive the immediate exposure mortality. Personal protection, decontamination and communication with proper local health and civil authorities are advised.

Hospital Roles

Review all relevant disaster response plans and ensure that designated staff are familiar with their content and strategies.

Establish internal and external lines of communication. Ensure that the medical staff is aware of the need to report suspicious cases of illnesses to public health authorities, and are familiar with who they should contact. Have in place dedicated staff, phones and fax machines to support rapid reporting.

Hospital leaders should establish collaborative strategies for communicating with neighboring hospitals, civic leaders and public health authorities.

Take inventory of pharmaceutical and antibiotic supplies, both at central and satellite facilities. Routinely update this list.

Assess routine staffing and emergency call-up plans and ensure that these are supported with communication and transportation strategies. Update the roster of essential personnel.

Maintain ongoing primary and redundant communication systems.

Ensure that appropriate health care professionals (e.g., emergency and urgent care personnel, infection control and infectious diseases professionals) are aware of the importance of reporting unusual disease presentations, disease clusters and atypical patterns of hospital use and know the mechanisms to do reporting.

Physician Roles

Develop an increased awareness of the ongoing threat of bioterrorism.

Become familiar with and develop a working knowledge of the most likely and dangerous pathogens as identified by the CDC (Note Web links below).

Become familiar with relevant lines of communication and important phone numbers (hospital epidemiologist, state epidemiologist, local health department), and the CDC emergency number.

Monitor disease patterns and patient volumes in clinics and offices. Immediately notify the appropriate authorities if you suspect an unusual event or need medical guidance.

Patients can be referred to the CDC public inquiry phone number for information about infectious diseases and bioterrorism preparedness response efforts. Have referral numbers for mental health and support services available for your patients. (See list of numbers below.)

The CDC is aware that a number of physicians have received requests for prescriptions for antibiotics to be used in the event of a bioterrorist attack. Informed your patients that Centers for Disease Control maintains a National Pharmaceutical Stockpile of large quantities of antibiotics and vaccines that could be distributed in the event of an epidemic brought on by an act of bioterrorism.

Public Health Roles

Local and state public health agencies should collectively review bioterrorism response plans. Attention should be given to assuring the integration of response plans, including mechanisms for sharing resources and personnel as needed.

Syndromic surveillance procedures should be put in place to monitor and detect atypical disease presentations and clusters. Both passive and active surveillance systems should be examined and refined across public health agencies and with reporting sources.

Establish and maintain capacity to accept reports of unusual disease events 24 hours a day, seven days a week. Ensure systems of continual, bi-directional communication between public health agencies and hospitals under their purview.

Appropriately trained disease investigation staff should be available for immediate mobilization and deployment as needed. Staffing levels should be reviewed and plans devised to determine non-urgent public health functions and clinics if it is necessary to pull additional clinical and field staff for urgent investigation activities.

Assess communication systems, including procedures for immediately contacting public health and political leaders. Systems should be assessed to ensure that appropriate authorities could be contacted at the outset of an emergency. Mechanisms for maintaining ongoing communication, including pagers, cell phones and wireless e-mail systems, should be assessed and tested. All staff that provide on-call and disease investigation response and decision-making should be adequately resourced for continuous communications.

Hold regular meetings with all appropriate government and non-government agencies and organizations to continually review and refine plans.

Important Web Sites and Information

CDC Emergency Number (770) 488-1700
CDC Emergency Chemical and Biological Hotline (770) 424-8802
CDC Public Inquiry Number (404) 639-3534, (800) 311-3435
CDC bioterrorism Web site: www.bt.cdc.gov

JAMA publications:

Anthrax as a Biological Weapon: Medical & Public Health Management

http://jama.ama-assn.org/issues/v281n18/ffull/jst80027.html

Botulinum Toxin as a Biological Weapon: Medical & Public Health Management

http://jama.ama-assn.org/issues/v285n8/ffull/jst00017.html

Plague as a Biological Weapon: Medical & Public Health Management

http://jama.ama-assn.org/issues/v283n17/ffull/jst90013.html

Smallpox as a Biological Weapon: Medical & Public Health Management

http://jama.ama-assn.org/issues/v281n22/ffull/jst90000.html

Tularemia as a Biological Weapon: Medical & Public Health Management

http://jama.ama-assn.org/issues/v285n21/ffull/jst10001.html

Weapons of Mass Destruction Events With Contaminated Casualties: Effective Planning for Health Care Facilities

http://jama.ama-assn.org/issues/v283n2/ffull/jst90100.html

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Examination

(A score of 70% or better must be achieved to successfully complete this activity)

1. The Health Alert Network (HAN) provides all the following except:

- ❍ Internet access to training in bioterrorism.
- ❍ Early warning to local, State and Federal agencies in regard to terrorist treats
- ❍ Tells local or State what action or preventive measures are required.
- ❍ Provides teams of physicians to counter a terrorist threat.
- ❍ Enables local authorities to access CDC disease guidelines.

2. The Federal response to a terrorist attack includes a two-tiered plan to deliver medications to the local scene. This is directed by;

- ❍ Federal Emergency Management Agency
- ❍ Department of Defense
- ❍ Office of Homeland Security
- ❍ Center for Disease Control and Prevention
- ❍ Food and Drug Agency

3. Domestic terrorists have already used pathogens against citizens of the United States in order to disrupt a local election. The incident affecting over 200 victims in Dalles, Oregon, involved which pathogen?

- ❍ Clostridia
- ❍ Salmonella
- ❍ Staphylococcus B toxin
- ❍ Plague
- ❍ Brucella Abortus

4. In dealing with the future threat of bioterrorism, physicians should :

- ❍ Report all suspicious illness trends to the local authorities.
- ❍ Learn information about the most common biologic and chemical agents as recommended by the Center for Disease Control and Prevention.
- ❍ Become familiar with and post important phone numbers to local health and law enforcement authorities.
- ❍ Not prescribe unnecessary antibiotics in the face of public demands such as the recent anthrax attacks.
- ❍ All of the above.

Please continue to next page

5. LRN refers to the laboratory Response Network. The following are true about this network except:

- ❍ More than 100 laboratories are participating in the LRN
- ❍ Of the four types of Labs, Level D is the most proficient and secure.
- ❍ One objective is to provide uniform results.
- ❍ One objective is to provide better communications
- ❍ Anthrax can only be tested in level A laboratories

6. Public health agencies traditionally have been most involved with addressing threats from: (choose one) Choose best answer

- ❍ chemical agents
- ❍ biological agents
- ❍ nuclear agents
- ❍ agents which cause food poisoning only.
- ❍ Viral diseases such as West Nile.

7. You can refer your patients to the _____ for information about infectious diseases and bioterrorism preparedness.

- ❍ Health Alert Network
- ❍ National Pharmaceutical Stockpile
- ❍ Center for Disease Control
- ❍ Federal Bureau of Investigation
- ❍ Occupational Safety and Health Administration

8. Physicians should immediately report unusual disease patterns to:

- ❍ local public health department
- ❍ local fire department
- ❍ Environmental Protection Agency
- ❍ The Office of Homeland Security
- ❍ The Federal Bureau of Investigation

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9. According to the Center for Counterproliferation Research, the assessment of available resources to respond to bioterrorism is usually:

- ❍ accurate
- ❍ underestimated
- ❍ overestimated
- ❍ ignored

10. The CDC's _____ has large quantities of anitbiotics and vaccines ready for distribution in the event of a bioterrorism attack.

- ❍ National Pharmaceutical Stockpile
- ❍ Federal Emergency Management Agency
- ❍ Laboratory Response Network
- ❍ Pharmaceutical Manufacturer's Assistance Network
- ❍ Agency for Toxic Substances and Disease Registry

11. Following a suspected case of acute sarin poisoning, the initial drug of choice is:

- ❍ Epinephrine
- ❍ Theophylline
- ❍ PAM
- ❍ Atropine
- ❍ Amyl nitrate

12. When diagnosing nerve gas poisoning, all the following are true except:

- ❍ Reduction of vision often occurs
- ❍ Mydriasis occurs early and disappears late.
- ❍ Diarrhea and abdominal symptoms occur.
- ❍ Death can be seen rapidly.
- ❍ Headaches occur that can persist for several weeks.

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13. To combat convulsions caused by tabun, one should utilize which pharmaceutical agent preferably?

- ❍ Mestinon
- ❍ Diazepam
- ❍ Dilantin
- ❍ Atropine
- ❍ Phenobarbital

14. Pretreatment of nerve poisoning with pyridostigmine is _____ effective.

- ❍ 30-40%
- ❍ 20-30%
- ❍ 50-60%
- ❍ Not effective except if used with Soman.
- ❍ 80-90%

15. A measure of concentration of an agent per minute is termed the:

- ❍ LD_{50}
- ❍ Dosage
- ❍ ID_{50}
- ❍ Ct
- ❍ LCt_{50}

16. Which fact about chemical gases is false?

- ❍ Iraq used chemical agents in its war with Iran
- ❍ A Japanese cult used nerve gas as a terrorist act.
- ❍ Chemical gases were more popular in World War II than World War I.
- ❍ The most common agent used in intentional poisoning in the last 90 years is cyanide.
- ❍ Nerve gas can penetrate plastic and rubber.

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17. State law mandates that the _____ act as the principle initial response agency, and perform triage and risk assessment.

- ❍ Center for Disease Control
- ❍ Department of Health (State Office)
- ❍ Agency for Health and Human Services
- ❍ Federal Bureau of Investigation
- ❍ Local health department.

18. All of the following about treating nerve gas are true except:

- ❍ Miosis is not expected to change with the administration of atropine.
- ❍ Managing excessive secretions can be lifesaving.
- ❍ Delivering Pralidoxime is not important if effective atropine dosage is provided especially with GA.
- ❍ Oxygenation, and managing airways is very important in these patients.
- ❍ Decontamination is less relevent with non-persistent gases not dispersed in a liquid droplet.

19. At a low Ct, the first sign or symptom observed is:

- ❍ Tightness of chest
- ❍ Rhinorrhea
- ❍ Dimness of vision
- ❍ Diarrhea
- ❍ Miosis

20. Identification of nerve gas is not possible through

- ❍ Characteristic odor
- ❍ M8 strips
- ❍ Chromatographic methods
- ❍ A Fox (Fuchs) detection vehicle
- ❍ Specific label on dispersing canister

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