



Bioterrorism Preparedness — Anthrax



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The World Trade Center and Pentagon disaster and the bioterrorist events of 2001 have dramatically advanced the need for veterinarians, physicians, all other allied-health professionals, livestock and poultry producers and the general public to become more knowledgeable about possible biologic agents that terrorists might release. While direct exposure to disease agents in human beings from bioterrorist attacks has been in the spotlight, livestock and the nation's food and water supplies are also possible targets.

Why Anthrax?

Of all the biologic agents, why might anthrax be the first choice? Anthrax could be a desirable agent to a terrorist because it is cheap, effective, easy to produce and simple to store (the highly resistant and dormant spores have been shown to survive at least 60 years in soil in a laboratory).

From an economic viewpoint, biological weapons are a very inexpensive way to inflict casualties. Research conducted during the cold war era found that the costs per square kilometer to deliver weapons of mass destruction for civilian targets (in 1969 US dollars) was \$2,000 for conventional weapons, \$800 for nuclear, \$600 for

chemical and \$1 for biological weapons. It is expected that today's costs could likely be extrapolated with similar cost ratios. (Note: the United States ceased the production of biological weapons in 1972, after the world's nations signed a treaty banning them. Consequently, there is a dearth of research in recent years.)

Studies performed in the 1970s comparing brucellosis, Q-fever, tularemia and anthrax found that after a **hypothetical** airplane release of 50 kg of agent along a 2 km line upwind of a population center of 500,000, all agents caused incapacitation of 100,000 or more inhabitants and reached downwind for at least 10 km. Anthrax killed 95,000 people and incapacitated another 125,000 inhabitants and ranged downwind for more than 20 km, further than any other agent in this simulation.

Anthrax in People

Symptoms

Depending on the route of entry into the body, infection by anthrax organisms produces three recognized forms of disease in human beings — cutaneous, pulmonary and gastrointestinal anthrax. Rare cases of anthrax meningitis have also been documented.

The cutaneous form is the most common and accounts for more than 90 percent of the cases in people. It has an incubation period of 2 to 6 days after inoculation of a spore or vegetative bacilli into a wound. A reddened, raised lesion develops that may be mistaken for an insect bite. It develops into a blister that later becomes black and very obvious. Edema (swelling or accumulation of fluid) often extends to the associated lymph nodes and beyond. A lesion on the head or neck can produce throat swelling so severe that a tracheal tube must be placed to insure a clear air passage. Mortality is low if treated but can approach 20 percent in untreated cases.

The pulmonary form has an incubation period of 1 to 6 days after inhaling the anthrax spores. It begins like many common respiratory infections with fever, malaise, muscle pain and coughing. In the second phase, 3 to 5 days later, the patient suddenly develops respiratory distress, sweating, cyanosis and shock. Death may occur within 24 hours. Mortality is close to 100 percent if untreated and may be as high as 80 percent, even with treatment.

The incubation period of the gastrointestinal form is 12 hours to 5 days after eating contaminated

meat. The patient develops fever, vomiting, bloody diarrhea and malaise. Mortality can be close to 50 percent if untreated.

After an airplane release of anthrax spores, exposure of human beings through dermal (skin cuts and abrasions) routes would likely cause an estimated 20 percent mortality rate in untreated cases; oral routes, 25 to 60 percent; and inhalation, as high as 100 percent. The mortality rate from an individual with multiple exposure routes would be more difficult to predict.

Treatment and Prevention

Treatment is with ciprofloxacin, doxycycline or penicillin. Ciprofloxacin is used as the antibiotic of choice for possible genetically engineered, biologic warfare strains of anthrax that are resistant to penicillin and doxycycline.

Also, inhalation anthrax is very difficult to treat, especially after symptoms are apparent. Even high dose antibiotic therapy may reduce the mortality rate only to 80 percent. In addition, an extended duration of therapy (60 days) is recommended for inhalation exposure because of the persistence of spores that are resistant to antibiotics. Even with long term antibiotic therapy, persistent spores in the respiratory tract may germinate after treatment has ended to cause anthrax many weeks after the initial exposure. No evidence supports the existence of persistent spores associated with the gastrointestinal form of anthrax.

After a terrorist attack, possibly the best case management option for physicians is an extended course of ciprofloxacin, combined with administration of human anthrax vaccine.

Members of the U.S. armed forces and emergency essential Department of Defense employees and contractors assigned to high threat

areas may have been immunized with human anthrax vaccine. The current vaccination schedule is three subcutaneous inoculations 2 weeks apart, followed by doses at 6, 12 and 18 months and annual boosters. This vaccine is not available to the general public.

Human anthrax vaccine information is available from the Texas Department of Health (<http://www.tdh.state.tx.us/>) or at the Centers for Disease Control and Prevention's *Morbidity and Mortality Weekly Report* (<http://www.cdc.gov/>), "Use of Anthrax Vaccine in the United States — Recommendations of the Advisory Committee on Immunization Practices," Dec. 15, 2000, Vol.49, No. RR-15 (404-639-3158 [p]) and <http://www.anthrax.osd.mil>.

Anthrax Signs in Animals

Animals would also be casualties of a terrorist attack. Livestock, deer and other wild ruminants usually become infected when they ingest anthrax spores while grazing or in contaminated feed (e.g. domestic and feral swine). The incubation period is 3 to 7 days and can be peracute, acute or chronic. In the peracute form, an animal that was normal just a few hours earlier may be found dead. Cattle, sheep, goats and deer typically have the peracute form.

Animals with the acute form may rapidly develop fever (up to 107.6 degrees F), stagger, tremble and have signs of abdominal pain and respiratory distress. They may have blood-tinged diarrhea, blood in the urine and milk and hemorrhaging from the mouth and nose. Pregnant animals may abort. Animals may die within 24 hours, with convulsions in the terminal stage of the disease. The acute form is more common in cattle, sheep, horses and deer.

In swine, the disease tends to be chronic. Swelling in the head and neck often interferes with breathing and swallowing and may cause death by asphyxiation. There may be blood-tinged mucous discharge from the mouth and snout. Some affected swine may recover without treatment. The chronic form is also seen in horses and dogs. Chronic cases of anthrax are more responsive to antibiotic treatment.

Although cats and dogs may develop anthrax from ingesting contaminated meat, both species seem to be resistant to inhalation anthrax. Isolation, decontamination and medication of cats and dogs exposed to anthrax spores would be important procedures after a bioterrorist event.

Anthrax can resemble other conditions that cause sudden death. In cattle and sheep, this includes clostridial infections, bloat, lightning strike, acute leptospirosis, bacillary hemoglobinuria, anaplasmosis, babesiosis, and acute poisoning with bracken fern, sweet clover, lead or blue-green algae. In horses, acute equine infectious anemia, colic, lightning strike, lead poisoning and blue-green algae poisoning may resemble anthrax. In swine, classical swine fever (hog cholera), African swine fever, and pharyngeal malignant edema symptoms are similar to anthrax. Poisoning and non-fatal vehicle collision could mimic anthrax in deer.

Containment and Treatment

The carcass of an animal killed by anthrax generally shows little or no rigor mortis, and there is usually dark blood oozing from the mouth, nose and anus (the blood may not clot). The body will be bloated and will decompose rapidly. **Do not cut into a suspicious carcass!** Veterinarians are trained to collect a blood sample from a large vein collected through the unopened skin for submission for laboratory confirmation.

Treatment in naturally occurring cases is more successful if it occurs early in the course of the disease. The recommended twice daily dose of penicillin IM (intramuscular) for livestock is 22,000 units/kg (10,000 units/pound) for 5 days. The daily oxytetracycline dose is 5 mg/kg (2.3 mg/lb) for all species. It may be given as an IM or by IV (intravenous) injection (slowly) in divided doses for at least 5 days (up to 26 to 28 days withdrawal time, depending on the product used). An alternative antibiotic such as ciprofloxacin may be used if antibiotic resistant anthrax is used in a terrorist attack. Extra-label usage of penicillin as indicated above or ciprofloxacin would require an extended withdrawal time of at least 30 days in food animals. Extra-label use means for purposes or at dosages not approved. Only veterinarians can prescribe extra-label drugs — when a veterinary/client-patient relationship exists. On their own, producers cannot prescribe or use drugs in an extra-label manner.

The disease management technique of isolating sick animals undergoing treatment from healthy-appearing animals should be practiced at the immediate premise. Animals should not be moved off the premise until at least 10 days after all livestock are vaccinated and after proper disposal of all carcasses. The number of quarantine days may be extended in the special case of terrorist attack, when livestock (and many other animals, pets, etc.) may be exposed by unnatural routes of infection (e.g. inhalation, cutaneous or combinations).

Veterinarians are required to report suspected cases to their respective state animal health agency and department of human health. If anthrax is confirmed, the preliminary quarantine issued by the state animal health agency will be fully enforced.

Anthrax Vaccination in Animals

In anthrax outbreak situations, livestock deaths should start to subside at about 10 days after vaccination. A second dose of vaccine should be given 2 to 4 weeks later. Areas subjugated to terrorist attack and seeding of the ground with anthrax spores may be sources for anthrax infection for a long time (depending on soil type and seasonal environmental conditions). In those cases, it will be necessary to administer vaccine to livestock in these geographic locations at least once yearly, 4 weeks before the start of environmental conditions that foster seasonal anthrax outbreaks. These are the same recommendations for areas of the United States currently having seasonal endemic anthrax outbreaks (e.g. Southwest Texas).

Reactions to anthrax vaccine may include swelling at the injection site, fever for several days, lowered milk production and abortion. Milk from dairy cows developing fever after vaccination should be destroyed. Antibiotics given within 7 days of vaccine administration can make the vaccine ineffective since it is a live attenuated biologic (formulated with live organisms). Animals should not go to slaughter until at least 60 days after vaccination.

Environmental Cleanup

The best ways to prevent future anthrax outbreaks is to keep from releasing more spores into the environment and to destroy existing spores. Anthrax bacteria-contaminated carcasses, bedding, soil and other materials should be burned as soon as possible. Burn carcasses where they lie. If carcasses must be moved, use a sled so as not to spread anthrax organisms by dragging the carcass across the ground. **Remember, do not open the carcass.** The vegetative form of the

anthrax bacteria in the carcass is killed by burning. If the carcass is opened and vegetative forms are exposed to air, the transformation to the spore form will be a future source of infection. Thorough burning kills spores.

In the event of a terrorist anthrax attack that kills livestock and contaminants pets, personnel in respirators and protective clothing will perform environmental clean up, decontaminate pets and burn dead animals. (Anthrax vaccination alone in clean up workers may not provide complete protection if work is performed close to the release point, so personal protective gear and respirators are a necessity). Contaminated equipment will then have to be sanitized with a sporocidal disinfectant, such as 5 percent sodium hydroxide (lye). Usual concentrations of many common disinfectants are not effective against anthrax spores.

Successful Anthrax Release Depends on Many Variables

Fortunately for livestock, pets and people — the potential targets — successful attack with biological weapons hinges on many variables. In the case of anthrax spores dispersed by airplane, any carrier that contains anthrax spores must be correctly formulated, and the weather conditions must be stable.

Mini-environments, such as wind currents between and among buildings in large population centers, make even distribution of agents unpredictable. Rainfall and change in wind directions also affect distribution. Remember that the same terrorists who successfully killed Japanese citizens with Sarin gas were unsuccessful with anthrax spores and botulinum toxin releases. Researchers know that even under the most controlled conditions, it is sometimes very difficult

to consistently cause experimental disease from various bacterial agents by direct animal inoculation. Aerosol exposure might be even less reliable.

Although anthrax spores delivered by postal letters have recently caused successful human exposures, mass exposure through aerosol release might not be as successful.

A bioterrorist attack might be attempted indirectly through food or water. Any food product suspected or found to be contaminated with anthrax organisms should be destroyed, preferably by incineration. Livestock producers should be alert to never send to slaughter any animal showing possible signs of anthrax. Also, do not touch, field dress or process the carcass of deer, other wild ruminants or livestock that may have been incubating or showing symptoms of anthrax prior to harvest. Do not eat the meat or use other products from such animals.

Attempts to cause anthrax through contamination of water may not be very successful. Within 24 hours of experimental inoculation into water, vegetative anthrax organisms were undetectable. Less information seems to be available on the possible transmission via spores

through contaminated water. Testing for the presence of *Bacillus anthracis* by experts would be the first step for evaluation of such a scenario.

Be Prepared

In summary, what can people do to prepare for the possibility of a terrorist attack by anthrax or other bioterrorist agents? They can

- Know the clinical signs for and countermeasures against the most probable bioterrorist agents.
- Talk to neighbors and become acquainted with their pets and livestock.
- Report any suspicious behavior in people or any increase in animal deaths anywhere and everywhere you go.
- Become involved in local, state or national efforts to prepare for these possible emergencies.

For more information

Bruce Lawhorn, "Anthrax" fact sheet (L-5402, July 2001), Texas Cooperative Extension, The Texas A&M University System, College Station, Texas, Web site <http://texaserc.tamu.edu>.

Centers for Disease Control and Prevention (CDC) Web site <http://www.bt.cdc.gov>.

Judith Miller, Stephen Engelberg and William Broad. *Germs: Biological Weapons and America's Secret War*. Simon and Schuster, Inc. Rockefeller Center, 1230 Avenue of the Americas, New York, NY 10020, 2001, (800) 456-6798.

Frederick R. Sidell, William C. Patrick, III, and Thomas R. Dashiell, *Jane's Chemo-Bio Handbook 2000*, Jane's Information Group, 1340 Braddock Place, Suite 300, Alexandria, VA 22314, (703) 683-3700, e-mail info@janes.com.

The Journal of the American Medical Association (JAMA) Consensus Statement, "Anthrax as a Biologic Weapon," *Medical and Public Health Management*, JAMA Web site <http://jama.ama-assn.org/>.

U.S. Department of Health and Human Services (HHS) Web site <http://www.hhs.gov/news>.

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