

ANTHRAX

ICD-9 022; ICD-10 A22

(Malignant pustule, Malignant oedema, Woolsorter disease, Ragpicker disease)

1. Identification—An acute bacterial disease that usually affects the skin, but may rarely involve the oropharynx, mediastinum or intestinal tract. In cutaneous anthrax, itching of exposed skin surface occurs first, followed by a lesion that becomes papular, then vesicular and in 2–6 days develops into a depressed black eschar. Moderate to severe and very extensive oedema usually surrounds the eschar, sometimes with small secondary vesicles. Pain is unusual and, if present, is due to oedema or secondary infection. The head, forearms and hands are common sites of infection. The lesion has been confused with human Orf (see Orf virus disease). Obstructive airway disease due to associated oedema may complicate cutaneous anthrax of the face or neck. Untreated infections may spread to regional lymph nodes and the bloodstream with overwhelming septicaemia. The meninges can become involved. Untreated cutaneous anthrax has a case-fatality rate between 5% and 20%; with effective treatment, few deaths occur. The lesion evolves through typical local changes even after the initiation of antibiotherapy.

Initial symptoms of inhalation anthrax are mild and nonspecific and may include fever, malaise and mild cough or chest pain; acute symptoms of respiratory distress, X-ray evidence of mediastinal widening, fever and shock follow in 3–5 days, with death shortly thereafter. Intestinal anthrax is rare and more difficult to recognize; it tends to occur in explosive food poisoning outbreaks where abdominal distress is followed by fever, signs of septicaemia and death in typical cases. An oropharyngeal form of primary disease has been described.

Laboratory confirmation is through demonstration of the causative organism in blood, lesions or discharges by direct polychrome methylene blue (M'Fadyean)-stained smears or by culture, rarely by inoculation of mice, guinea pigs or rabbits. Rapid identification of the organism through immunodiagnostic testing, ELISA and PCR may be available in certain reference laboratories.

2. Causative agent—*Bacillus anthracis*, a Gram-positive, encapsulated, spore forming, nonmotile rod (specifically the anthrax spores of *B. anthracis* are the infectious agent; vegetative *B. anthracis* rarely establish disease.)

3. Occurrence—Primarily a disease of herbivores; humans and carnivores are incidental hosts. In most industrialized countries, anthrax is an infrequent and sporadic human infection; it is an occupational hazard primarily of workers who process hides, hair (especially from goats), bone and bone products and wool; and of veterinarians and agriculture and wildlife workers who handle infected animals. Human anthrax is endemic in the agricultural regions of the world where anthrax in animals is

common, such as Africa and Asia, south and central America, southern and eastern Europe. New areas of infection in livestock may develop through introduction of animal feed containing contaminated bone meal. Environmental events such as floods may provoke epizootics. Anthrax has been deliberately used to cause harm; as such, it could present in epidemiologically unusual circumstances.

4. Reservoir—Animals (normally herbivores, both livestock and wild-life) shed the bacilli in terminal hemorrhages or blood at death. On exposure to the air, vegetative cells sporulate and the *B. anthracis* spores, which resist adverse environmental conditions and disinfection, may remain viable in contaminated soil for years. Dormant anthrax spores may be passively redistributed in the soil and adjacent vegetation through the action of water, wind and other environmental forces. Scavengers feeding on infected carcasses may also disperse anthrax spores beyond the site of death, either through blood and viscera adhering to their fur or feathers or through excretion of viable anthrax spores in fecal matter. Dried or otherwise processed skins and hides of infected animals may harbour spores for years and are the fomites by which the disease is spread worldwide.

5. Mode of transmission—Contact with tissues of animals (cattle, sheep, goats, horses, pigs and others) dying of the disease; possibly also through biting flies that have partially fed on such animals; contact with contaminated hair, wool, hides or products made from them (e.g. drums, brushes, rugs); or contact with soil associated with infected animals or with contaminated bone meal used in gardening. Inhalation anthrax results from inhalation of spores in risky industrial processes—such as tanning hides and processing wool or bone—with aerosols of *B. anthracis* spores in an enclosed, poorly-ventilated area. Intestinal and oropharyngeal anthrax may arise from ingestion of contaminated undercooked meat; there is no evidence that milk from infected animals transmits anthrax. The disease spreads among grazing animals through contaminated soil and feed; and among omnivorous and carnivorous animals through contaminated meat, bone meal or other feeds derived from infected carcasses. Accidental infections may occur among laboratory workers.

In 1979, 66 persons were documented to have died of anthrax and 11 infected persons were known to have survived in an outbreak of largely inhalation anthrax in Yekaterinburg (Sverdlovsk), the Russian Federation; numerous other cases are presumed to have occurred. Investigations disclosed that the cases occurred as the result of a plume emanating from a biological research institute and led to the conclusion that the outbreak had resulted from an accidental aerosol related to biological warfare studies.

6. Incubation period—From 1 to 7 days, although incubation periods up to 60 days are possible. In the Sverdlovsk outbreak, incubation periods extended up to 43 days.

7. Period of communicability—Person-to-person transmission is rare. Articles and soil contaminated with spores may remain infective for several years.

8. Susceptibility—There is some evidence of inapparent infection among people in frequent contact with the infectious agent; second attacks can occur, but reports are rare.

9. Methods of control—

A. Preventive measures:

- 1) Immunize high-risk persons with a cell-free vaccine prepared from a culture filtrate containing the protective antigen (in the USA: Bioprot Corporation, 3500 N. Martin Luther King Jr Boulevard, Lansing MI 48909). This vaccine is effective in preventing cutaneous and inhalational anthrax: it is recommended for laboratory workers who routinely work with *B. anthracis* and workers who handle potentially contaminated industrial raw materials. It may also be used to protect military personnel against potential exposure to anthrax used as a biological warfare agent. Annual booster injections are recommended if the risk of exposure continues.
- 2) Educate employees who handle potentially contaminated articles about modes of anthrax transmission, care of skin abrasions and personal cleanliness.
- 3) Control dust and properly ventilate work areas in hazardous industries, especially those handling raw animal materials. Maintain continuing medical supervision of employees and provide prompt medical care of all suspicious skin lesions. Workers must wear protective clothing; adequate facilities for washing and changing clothes after work must be provided. Locate eating facilities away from places of work. Vaporized formaldehyde has been used for disinfection of workplaces contaminated with *B. anthracis*.
- 4) Thoroughly wash, disinfect or sterilize hair, wool and bone meal or other feed of animal origin prior to processing.
- 5) Do not sell the hides of animals exposed to anthrax or use their carcasses as food or feed supplements (bone or blood meal).
- 6) If anthrax is suspected, do not necropsy the animal but aseptically collect a blood sample for culture. Avoid contamination of the area. If a necropsy is inadvertently performed, autoclave, incinerate or chemically disinfect/fumigate all instruments or materials used.

Because anthrax spores may survive for years if the carcasses are buried, the preferred disposal technique is incineration at the site of death or removal to a rendering plant, ensuring that

no contamination occurs en route to the plant. Should these methods prove impossible, bury carcasses at the site of death as deeply as possible without digging below the local water table level. Laboratory studies of close relatives of *B. anthracis* in the *Bacillus* genus have shown that exposure to elevated levels of calcium cations can extend the viable lifespan of spores. The same phenomenon could occur with *B. anthracis* spores and the addition of lye or quicklime to a carcass (originally applied in the—not always confirmed—hope of speeding up putrefaction and discourage scavengers) could actually assist in the survival of anthrax spores.

- 7) Control effluents and wastes from rendering plants that handle potentially infected animals and from factories that manufacture products from hair, wool, bones or hides likely to be contaminated.
- 8) Promptly immunize and annually reimmunize all domestic animals at risk. Treat symptomatic animals with penicillin or tetracyclines; immunize them after cessation of treatment. These animals should not be used for food until a few months have passed. Treatment in lieu of immunization may be used for animals exposed to a discrete source of infection, such as contaminated commercial feed.

B. Control of patient, contacts and the immediate environment:

- 1) Report to local health authority: Case report obligatory in many countries, Class 2 (see Reporting). Also report to the appropriate livestock or agriculture authority. Even a single case of human anthrax, especially of the inhalation variety, is so unusual in industrialized countries and large urban centers that it warrants immediate reporting to public health and law enforcement authorities for consideration of deliberate use.
- 2) Isolation: Standard precautions for the duration of illness for cutaneous and inhalation anthrax. Antibiotherapy sterilizes a skin lesion within 24 hours, but the lesion progresses through its typical cycle of ulceration, sloughing and resolution.
- 3) Concurrent disinfection: Of discharges from lesions and articles soiled therewith. Hypochlorite is sporicidal and good when organic matter is not overwhelming and the item is not corrodable; hydrogen peroxide, peracetic acid or glutaraldehyde may be alternatives; formaldehyde, ethylene oxide and cobalt irradiation have been used. Spores require steam sterilization, autoclaving or burning to ensure complete destruction. Fumigation and chemical disinfection may be used for valuable equipment.
- 4) Quarantine: Not applicable.
- 5) Immunization of contacts: Not applicable.

- 6) Investigation of contacts and source of infection: Search for history of exposure to infected animals or animal products and trace to place of origin. In a manufacturing plant, inspect for adequacy of preventive measures as outlined in 9A. As mentioned in 9B1, it may be necessary to rule out a case of deliberate use for all human cases of anthrax, especially for those with no obvious occupational source of infection.
- 7) Specific treatment: Penicillin is the drug of choice for cutaneous anthrax and is given for 5-7 days. Tetracyclines, erythromycin and chloramphenicol are also effective. The U.S. military recommends parenteral ciprofloxacin or doxycycline for inhalation anthrax though the duration of treatment is not well defined.

C. Epidemic measures: Outbreaks may be an occupational hazard of animal husbandry. Occasional epidemics in the USA and other industrialized countries are local industrial outbreaks among employees who work with animal products, especially goat hair. Outbreaks related to handling and consuming meat from infected cattle have occurred in Africa, Asia, and the former Soviet Union.

D. Disaster implications: None, except in case of floods in previously infected areas.

E. International measures: Sterilize imported bone meal before use as animal feed. Disinfect wool, hair and other products when indicated and feasible.

F. Measures in case of deliberate use: A recent incident of deliberate anthrax use has occurred in the USA in 2001. The general procedures for dealing with such civilian occurrences include the following:

- 1) Anyone who receives a threat about dissemination of anthrax organisms should notify the relevant local criminal investigative authority immediately. In the USA, the Federal Bureau of Investigation (FBI) has primary responsibility for the investigation of such biological threats.
- 2) Other agencies must cooperate and provide assistance as requested.
- 3) Where appropriate, local and state health departments should also be notified and be ready to provide public health management and follow-up as needed.
- 4) Persons who may have been exposed to anthrax are not contagious, and quarantine is not appropriate.
- 5) If the threat of exposure to aerosolized anthrax is credible or confirmed, persons at risk should begin postexposure prophylaxis with both an appropriate antibiotic (fluoroquinolones are

the drugs of choice; doxycycline is an alternative) and if available an inactivated cell-free vaccine may be considered because of uncertainty as to when or if inhaled spores may germinate or be cleared by the alveolar immune system. Postexposure immunization consists of 3 injections, starting as soon as possible after exposure and at 2 and 4 weeks after exposure. The vaccine has not been evaluated for safety and efficacy in children under 18 or in adults 60 or older.

- 6) All first responders should follow local protocols for incidents involving biological hazards.
- 7) Responders can be protected from anthrax spores by donning splash protection, gloves and a full face respirator with high-efficiency particle air (HEPA) filters (Level C) or self-contained breathing apparatus (SCBA) (Level B).
- 8) Persons who may have been exposed and may be contaminated should be decontaminated with soap and copious amounts of water in a shower. Bleach solutions are usually not required; a 1:10 dilution of household bleach (final hypochlorite concentration 0.5%) should be used only if there is gross contamination with the agent and it is impossible to remove the materials through soap and water decontamination. The bleach solution, to be used only after soap and water decontamination, must be rinsed off after 10 to 15 minutes.
- 9) All persons who are to be decontaminated should remove clothing and personal effects and place all items in plastic bags, which should be labelled clearly with owner's name, contact telephone number and inventory of contents. Personal items may be kept as evidence in a criminal trial or returned to the owner if the threat is unsubstantiated.
- 10) If the suspect item associated with an anthrax threat remains sealed (unopened), first responders should not take any action other than notifying the relevant authority and packaging the evidence. Quarantine, evacuation, decontamination and chemoprophylaxis efforts are *not* indicated if the envelope or package remains sealed. For incidents involving possibly contaminated letters, the environment in direct contact with the letter or its contents should be decontaminated with a 0.5% hypochlorite solution following a crime scene investigation. Personal effects may be similarly decontaminated.

[R. Diaz]

