

ANTHRAX

The Disease and Its History

Anthrax is a disease produced by spore-forming bacteria that primarily occurs in herbivores such as sheep, goats, cattle, and swine as a result of ingestion of naturally occurring infectious spores. Usually, man is only infected incidentally. The disease has been present worldwide for centuries and was probably the etiology of the *Fifth Plague*, which killed the Egyptians' livestock described in Exodus.¹⁸ However, as recently as 1945, an epidemic in Iran resulted in the deaths of a million sheep.¹⁹ Although "natural" anthrax in both animals and humans has mostly been eradicated in the industrialized nations, it still remains common in Third World countries.²⁰ A vaccine, which was developed as long ago as the 1880s,²¹ is readily available for animals, but rarely used in humans.

The natural disease in humans is caused by incidental contact with animals or animal products. Human-to-human transmission is not seen.²² Most cases that occur are usually occupationally related (e.g., in those people dealing with animals or animal products, such as sheepherders, slaughterhouse workers, butchers, or tanners).²³

The incidence of anthrax in the United States is low. Only 224 cases of cutaneous anthrax, the most common form of the disease, were reported between 1944 and 1994. Only 18 cases of rarely seen inhalational anthrax were reported for the entire twentieth century, with none occurring during the 25 years prior to September 11, 2001.²⁴ However, since the anthrax attacks of 2001, growing evidence has been presented to indicate that Al Qaeda terrorists are attempting to produce biological weapons, such as anthrax, to use in the United States.²⁵

The Responsible Organism

Bacillus anthracis, the responsible bacterial pathogen, is a large, spore-forming, Gram-positive bacillus, which is aerobic and non-motile. Under the microscope, it has the appearance of a jointed bamboo rod. Its name is derived from the Greek word *anthracis*, which means "coal." This term was probably used because of the black eschar so commonly seen with anthrax lesions of the skin, the most common form of disease.²⁶ Under adverse conditions, the bacillus forms spores that are extremely hardy and can survive for decades in

natural habitats. Basically, the bacterium forms an oval body (spore) within itself, through which it may enter an inactive (dormant) state. This inert form is highly resistant to extremes of cold or heat, to antibiotics, and to certain forms of radiation.²⁷ However, spores readily germinate when placed in blood or animal tissues, and in their vegetative state, they will multiply rapidly.²⁸

History of Biological Weaponry

B. anthracis was used as a biological weapon early in the twentieth Century. During World War I (WWI), the German Army attempted to use it as an agricultural or animal husbandry weapon against horses and reindeer in northern Norway to disrupt Allied supply lines.²⁹ It was also used as a weapon to infect Romanian sheep destined for Russia and to infect Argentinian livestock for export to Allied forces.³⁰

During WWII, the British developed 500-pound cluster bombs containing anthrax spores and also stockpiled “cattle cakes” laced with anthrax, which fortunately were never used.³¹ The British tested the efficacy of *B. anthracis* as a weapon by detonating shells filled with anthrax spores on Gruinard Island off the coast of Scotland; 36 years later, viable spores could still be found in the soil throughout the island. Decontamination of the island, which had not been undertaken until recently, required 280 tons of formaldehyde and 2000 tons of seawater.³² Also during WWII, the Japanese conducted experiments with anthrax on Chinese prisoners of war.³³

Later, during the Cold War, the Soviet Union’s biological warfare unit Biopreparat conducted extensive experimentations with *B. anthracis*. Unfortunately, in 1953, an accident occurred at Kirov that resulted in a spill of live anthrax spores into the city sewage system. Three years later, rats from the sewer were found to be infected with a mutated form of the bacillus that was extremely virulent. It was named Strain 836. Biological enhancements over subsequent years led to a tripling of its pathogenic potency. In addition, not only did the organism become highly resistant to heat and cold, but it also became easily adaptable to an aerosol delivery system.³⁴

For several decades after WWII, Biopreparat, with its 30,000 employees, developed weaponized systems for an impressive number of diseases: smallpox, bubonic plague, anthrax, Venezuelan equine encephalitis, tularemia, influenza, brucellosis, as well as Marburg,

Ebola, and Machupo virus infections. In addition Biopreparat developed hybrids, such as *Veepox* (smallpox and Venezuelan equine encephalitis viruses) and *Ebolapox* (smallpox and Ebola viruses).³⁵

In April 1979, an important unreported explosion occurred at Biopreparat's anthrax production facility near the city of Sverdlovsk (now renamed Yekaterinburg), releasing an aerosol of the new anthrax Strain 836, resulting in a large number of civilian deaths, involving at least 100 and perhaps up to 1,000 people.^{36,37,38} all of whom were located along the path of the prevailing wind, which carried the infectious spores.

In less sophisticated settings, anthrax was used as a weapon in 1978 in Rhodesia, where soldiers spread the spore among the cattle of the tribal trust lands. The soil is still contaminated from this act, resulting in a number of deaths among the inhabitants.³⁹

During the 1991 Gulf War, Iraq possessed an extensive biological weapons arsenal, including 50 bombs and five Scud/Al Hussein missile warheads filled with anthrax spores, several 122 mm rockets containing the same, and spray and drop tanks for fighter planes and for drones with a capacity of 2,000 liters of anthrax spores. The Americans reportedly bombed two bases where Iraqi aircraft had been fitted with two under-wing tanks carrying 300 liters of this anthrax preparation. Then U.S. Deputy Secretary of Defense Robertson stated that if this material had been sprayed over Kuwait City, millions of people could have been killed. Indeed, Saddam had given his Air Force commanders authority to use these weapons if Baghdad were overrun. Just prior to that war, then-U.S. Secretary of State James Baker delivered a written note from President George Herbert Walker Bush to Iraq's Deputy Prime Minister Tariq Aziz, stating that if chemical or biological weapons were used by Iraq, the United States would respond in the "strongest possible way."⁴⁰

Preparations of Anthrax Spores for Dispersal

One of the most daunting problems associated with trying to use anthrax as a biological weapon is the tendency of its spores to clump or stick together, making them not only vulnerable to human body defenses, but, most important, difficult to keep in a suspended state for subsequent dispersal. The challenge is to aerosolize spores after physiochemical methods are used to disrupt or break the clumps into sin-