Anthrax

I. Introduction & history:

Anthrax is ancient. It's been around since biblical times, and is mentioned by Homer, Virgil & Hippocrates.

- Some people attribute the sixth plague (in Exodus) to Anthrax.

It's primarily a disease of livestock, but can readily infect humans.

- Historically, it's mostly people working with hides, dead animals or sometimes livestock that were most prone to getting anthrax.

- Until treatments (and vaccines) were developed, it killed thousand of animals and people every year.

Obviously, it's of current concern because it was used to infect people shortly after the 9-11 attacks.

- Incidentally, it was also used (in addition to many other things) to try to justify the Iraq war.

- That's as close as we'll get to politics in here, but it is something to think about.

II. Cause

A bacteria, *Bacillus anthracis*. Rod shaped, anearobic, gram-positive.

- It has an endospore, which can make it difficult to eradicate.

- It comes in 89 different strains, of which the Ames strain is probably the most dangerous (the one used in 2001). The Vollum strain may be more virulent, though.

The bacteria was first isolated by Robert Koch in 1877.

III. Spread and infection

We'll stick with human manifestations of the disease (livestock often pick it up by eating infected grasses).

There are three ways of getting anthrax (and they all manifest themselves differently):

- Pulmonary: The bacteria or spores are inhaled. This form has a mortality rate of close to 100% (if untreated). People can get this from handling animal skins, wool, or such.

- Gastroinestinal: eating anthrax infected meat. Fatality is between 25% and 60% (depending partly on when treatment starts)

- Cutaneous (skin): skin is infected (from contact). Fatality is 20% if untreated.

Treated, this form is rarely fatal.

IV. Symptoms and course of disease

Pulmonary anthrax:

Inhaled spores are actually eaten by a phagocyte (or macrophage) and then transported to the lymph nodes.

- There they multiply and burst out of the macrophage.

- From there they can spread to the rest of the body, releasing toxins that cause tissue destruction, bleeding & death.

Incubation period can be over 6 weeks, but is usually 1 - 6 days.

Early symptoms are similar to the flu - fever, malaise, headache, nausea, vomiting.

- Followed by:

  - chest pain
  - respiratory distress
  - cyanosis (lack of oxygen)
  - shock & coma

Untreated fatality rate is close to 75%, though some say that the treatments for inhalation anthrax are useless.

Gastrointestinal anthrax:

Bacteria “germinate” and start to spread through any injury or wound within the gastrointestinal tract.

- From there they spread to the lymphatic system and multiply.

- Again, they spread out and start to release lots of toxins.

Symptoms can vary (even be asymptomatic), but include:

- fever, nausea, vomiting, abdominal pain & bloody diarrhea.

- can also cause lesions anywhere between the mouth and large intestine.

- toxins can cause bleeding of the mesentery and subsequent dying of tissue.

- toxins and tissue death can result in death

Cutaneous anthrax:

Infection usually stays localized, but it can spread (lymph nodes near infection site become tender)

Symptoms include an obvious bump:

- this can itch, but is usually painless
- develops into a sore with a black center.

- if it spreads, symptoms include fever, chills, and swollen/infected lymph glands.

This is the most common form of the disease

V. Treatment and prevention

There is a vaccine, though it's complicated to administer (needs six doses, and is rather painful).

Louis Pasteur introduced the first effective vaccine for anthrax (1881). He performed inoculated 25 sheep, left 25 sheep alone, and then infected all the sheep with anthrax. All the vaccinated animals survived, all the unvaccinated animals died.

(He also developed a vaccine for rabies, cholera & small pox)

Otherwise, treatment uses antibiotics:

- some probably remember the news about cipro (ciprofloxacin) during the anthrax attacks.

- Other antibiotics include doxycyline, penicillin and others.

- It's really important to start treatment as soon as anthrax is suspected.

- there seem to be conflicting statements as to how good antibiotics are for inhalation anthrax.

- one source says with early treatment mortality may drop to 50%.

- another says it makes no difference, it stays at 75%.

- however, the anthrax attacks had a mortality rate of about just under 50% (so maybe something was working after all).

Other means of prevention:

- because spores can spread so easily, it's very important to avoid contact.

- infected equipment must be disinfected (remember - this is difficult because of the endospores).

- bodies should be disposed by cremating (burial,or embalming may only spread the spores).

- sites infected with anthrax spores must be decontaminated

- this can involve all manner of really nasty chemicals in order to kill the spores.

- it can also be expensive:

- To clean the Senate office building cost $27 million. the Brentwood postoffice cost $130 million (and took 26 months).

VI. Anthrax and biological warfare

Anthrax is a nasty, deadly disease. But it probably wouldn't get that much attention except for one fact:

- it is and has been used in biological warfare.

First attempts were probably the British. In 1942 they conducted experiments on an island off Scotland:

- this island (Gruinard) was uninhabitable for the next 48 years!

- used the Vollum strain

- different methods were tried, including cakes impregnated with anthrax designed to wipe out cattle.

- originally, the thought was to drop these “cakes” on Germany in 1944, but all cakes were destroyed by setting fire to them in 1945.

- an anthrax bomb was also experimented with.

The U.S. also experimented with anthrax at Fort Detrick:

- experimented with dispersal methods by using harmless bacteria (not anthrax or anything related) over San Fransisco (1950) and into the New York City subway system (1966).

- this showed an entire subway system could easily be infected because of the movement of trains.

- President Nixon stopped all offensive biological weapons research in 1969.

Of course, the Soviets also experimented with anthrax.

- in 1979, a facility in Sverdlovsk (Ekaterinburg) accidentally released large amounts of anthrax spores:

- 94 people were infected, 68 died.

- since this happened after the Soviets signed on to an accord to end bioweapon production, they tried to cover this up in various ways.

Anthrax was also used on smaller scales elsewhere:

- In Rhodesia (now Zimbabwe) by the government to attack cattle and humans

Still, the main reason we're concerned is probably the anthrax attacks in 2001:

- These started on September 18, 2001

- Letters with anthrax spores were sent from Trenton, New Jersey in two sets:

    - first were coarse brown material that caused mostly cutaneous anthrax

    - second, much finer white powder that caused inhalation anthrax

- Letters were sent to prominent news men/women and politicians.

- The overall result was 22 infections, 11 of the pulmonary kind, of which 5 people died.

Where did the anthrax come from?

- as mentioned, it was the Ames strain, but to this day no one knows for sure what the source was.

- it was not weapons grade, though it was highly refined (at least the second batch).

- although one or two suspects were identified, no arrests have been made.

    - one of them (Dr. Steven Hatfill) has turned around and sued the FBI, Justice Department and others for violating his constitutional rights and for violating the Privacy act.

    - it's not clear what is happening with the other “suspect”.

Although it's not much in the news anymore, as recently as September 2007, Senator Leahy expressed dissatisfaction and suspects that there are people in the government that may know more about this.

Unfortunately this has been politicized recently.

- Perhaps this is justifiable (to some extent), but it does detract from getting to the answers, which is probably more important.