

Smallpox

I. Introduction

In 1518, the Aztec Empire included about 30 million people. By 1568, the estimates are that only 3 million people remained in the area covered by the Aztec Empire.

What happened?

- In 1519, Hernan Cortes landed in Mexico, followed by more Spaniards from Cuba a year later.
- An African slave who came in 1520 had smallpox.
- Cortes actually first beat up the second group of Spaniards (from Cuba), and then turned inland.
 - One of his soldiers contracted the disease.
- In fighting with the Aztecs, the Spanish eventually had to retreat (glossing over lots of details here), but the infected soldier died.
 - The Aztecs contracted smallpox from the dead soldier.
- It took Cortes some time to return to the Aztec capital. In the meantime a Spanish priest left a description of what happened:

"As the Indians did not know the remedy of the disease...they died in heaps, like bedbugs. In many places it happened that everyone in a house died and, as it was impossible to bury the great number of dead, they pulled down the houses over them so that their homes become their tombs."
- This left the Aztec army in tatters, and Cortes easily defeated the remnants.
 - His soldiers said they couldn't walk through the streets without stepping on the bodies of victims.

Some years later, the same thing happened to the Inca's. Between 60% and 90% of the population died.

In North America smallpox wiped out 90% of the Native American population on the Massachusetts coast (1617-1619).

Overall, some estimates say that 90 - 95% of the native population of the New World died due to smallpox.

And it's not just the new world:

The Plague of Athens in 430 B.C. may have been smallpox (33% mortality rate)

The Antonine plague may have been smallpox (killed between 2000 and 5000 people a day in

Rome during its height. (Incidentally - this seriously weakened the Roman Empire when it most needed men to fight off invaders)).

In India, around 400 a plague was described as coming with pustules & boils.

In the 18th century smallpox killed about 400,000 people every year (including 5 reigning monarchs)

The Franco-Prussian war triggered an outbreak that killed 500,000 people from 1870 - 1875.

Smallpox has a 30% mortality rate (in those with some resistance).

II. Causes

A virus belonging to the poxviridae - a double stranded DNA virus.

Closely related viruses cause cow pox, monkeypox & vaccinia

III. Spread and infection

Spreads through inhaling of the virus. It's highly contagious.

This usually comes from the mouth, nose or pharynx of an infected person.

- Being around someone (face to face) who's infected is a good way to spread smallpox.
- Also spreads through contact with bodily fluids or contaminated clothing.

It's most contagious 7 - 10 days after rash first appears (more on that soon), but stays contagious until rash disappears.

Humans are the only known hosts of smallpox (though monkeys have been infected in a lab setting).

After infection, the virus spreads to the mouth and throat areas, and local lymph nodes. Eventually it spreads into the bloodstream.

IV. Symptoms

There are two clinical forms of smallpox:

Variola minor: a rarer manifestation of smallpox. Symptoms are much milder and mortality rate is less than 1%.

Variola major: the most severe form of smallpox, most common:

Usually symptoms show up 10 to 12 days after infection. Initial symptoms are very similar to the flu (or even the cold):

- fever
- muscle pain
- malaise
- headache
- prostration (can't get up)
- nausea/vomiting
- backache

This is followed by more classic symptoms:

- lesions appear in mouth, throat, tongue, etc.
- fever drops
- lesions rupture, releasing large amounts of virus into saliva

About two days after this:

- skin lesions appear. Usually start on forehead, then spread to face, trunk, etc. fairly quickly (1 - 1 ½ days).

Disease then takes one of several different courses:

1) Typical:

- lesions become raised “papules”, filled with fluid
 - this is tissue debris, not pus.
- 7 - 10 days later pustules reach maximum size, and start to leak fluid
- then scab over
- if lesions are so numerous as to coalesce into sheets, then illness persists even if scabs start to form.
 - fatality rate in this case can be up to 62%.
- some “typical” cases remain very mild and even can be confused with chicken pox.
 - this form is rarely lethal (and sometimes occurs in vaccinated people).

2) Flat:

- lesions remain small, and mature slowly.
- some preliminary symptoms are a bit more severe
- almost always fatal

3) Hemorrhagic:

- lesions don't blister, instead there is much bleeding under the skin.
- bleeding can occur in the spleen, kidney, serosa, muscle, etc.
 - can interfere with coagulation factors.
- death occurs usually on the 5th to 7th day of the disease.

Death is due to a variety of factors:

- heart failure (in hemorrhagic smallpox)
- immune system may overreact
- flat type causes loss of fluid & electrolytes (similar to what might be caused by burns)
- viremia (spread of the virus throughout the body).
- and, of course, even if one survives smallpox, complications such as bronchitis and (again) pneumonia can set in and kill
- it is often also debilitating (causes permanent scarring, blindness (when eyes are affected), arthritis (when joints are affected), etc.)

V. Treatment and preventions

A little like rabies, a vaccination within a few days of being infected can stop or reduce the seriousness of the disease. Even later vaccination (before symptoms really get going) is of some benefit.

Otherwise, treatment is only “treatment of symptoms”.

Antivirals may help with smallpox (there is some evidence for this), but no one really knows since no one gets smallpox anymore.

The best thing, though, is inoculation.

Something along those lines was first tried in India:

- inhalation of powdered smallpox scabs.
- problem is that this was live smallpox virus
- mortality rate was between ½ and 2% for the treatment, but it did work!

Edward Jenner, a doctor/naturalist in England, discovered that milkmaids would never get smallpox.

- Investigating this, he discovered that exposure to cowpox would protect against smallpox.
- Jenner also coined the term “vaccine” which is from the Latin for cow (vacca).
- Using material from cowpox lesions, vaccinations spread rapidly to all parts of the world.
- These days the vaccine is based on a form of live smallpox virus
 - 1 to 2 people out of 1,000,000 may die from getting the vaccine.
 - usually from complications, not directly from the virus.
 - The effectiveness of the vaccine drops off after a number of years, revaccination lasts much longer, though.

VI. Smallpox has been eradicated (in the wild)

Effort was started in 1950.

- Progress was slow (with 2 million people dying every year as late as 1959). But eventually it started to work.
- Last major outbreak in Europe was in 1972 in Yugoslavia. The government enforced a quarantine and re-vaccinated the population with the help of the WHO.
- By 1975 smallpox was found only in the Horn of Africa (Ethiopia, Somalia), which were areas difficult to get to due to famine, civil war, etc. (unfortunately not much seems to have changed in Somalia)
- The good news is that smallpox has been completely eradicated. The last known case (in the wild) occurred in a hospital cook in Somalia in 1977 (who fortunately had the less severe form).
- BUT, in 1978 a photographer in England died of smallpox after photographing areas where smallpox virus stocks were kept in England.
 - This prompted the UK to destroy all smallpox stocks.
- Today, only two labs still have smallpox - the CDC in Atlanta, and the State Research Center of Virology and Biotechnology (VECTOR) in Koltsovo, Russia (where it is guarded by a regiment of troops).
- Initially, the WHO recommended destroying all remaining stocks, but now they've put a hold on that.....

VII. Biological warfare

The initial exposure of smallpox to people living in the New World was entirely accidental. But it wasn't long before this was done deliberately

- The British apparently tried using smallpox against the French and Indians during the French and Indian Wars (1754-63).
 - Blankets infected with smallpox were given to besieging Delawares during the siege of Fort Pitt (during talks).
 - It's not clear how "effective" this was:
 - Many American Indians did die of smallpox following this, but it's quite possible they were infected earlier.
- Possibly used during the American Revolutionary War:
 - Earlier in the war, the British had hoped to get the help of African Americans, so they offered freedom to those who would help them.
 - "Above 700 Negroes are come down the River in the Small Pox," wrote one British general to another. "I shall distribute them about the Rebell Plantations."
 - It didn't do much, because Washington's Army had been immunized, and the war was over a few weeks later anyway. Still, at least one American eyewitness suspected this was quite deliberate.
- The UK, USA, and even Japan investigated using smallpox as a biological weapon during World War II.
 - Was not considered effective due to the vaccine
- It is possible a mysterious disease outbreak in the Soviet Union in the 1970's might have been smallpox.
- The U.S. government is worried enough about smallpox that it keeps 300 million doses of vaccine on hand.
 - Research is ongoing, since the current vaccine does have side effects.
- Finally, is it a good idea to keep around???
 - In March of 2003, a researcher found an envelope with scabs from victims in a book on Civil war medicine.
 - Given enough knowhow, it might just be possible to extract DNA from these scabs to use in manufacturing some type of biological weapon.

- Although it'd be nice to keep destroy it all, perhaps an argument might be made for keeping it around.