

# FIXATION ON HISTOLOGY

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## The perils of anthrax

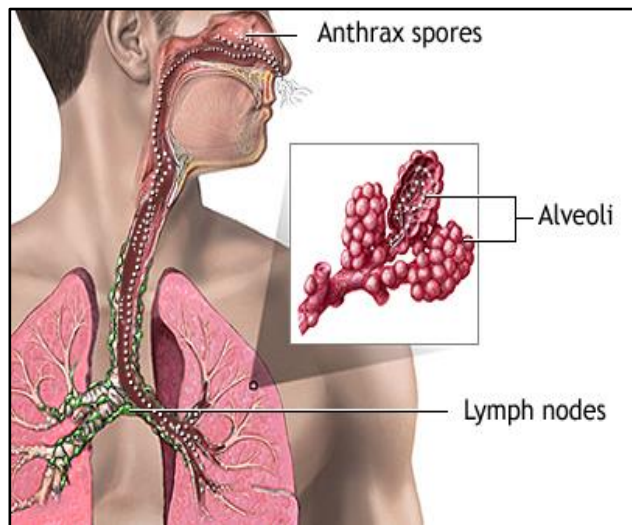
Anthrax is a bacterial infection caused by *Bacillus anthracis*, a Gram positive bacterium. The organism produces dormant spores that are able to survive in the environment for many decades. When the spores enter the body of an animal or human host, they activate and multiply, produce toxins as they spread and cause severe illness and death. Identified in 1875 by Robert Koch, anthrax was so named after the ancient Greek word for coal, derived from the jet black lesions found on infected skin. Often appearing in infected animal products, anthrax (also known as Hide Porter or Woolsorter's disease) is spread by contact with the bacterial spores through inhalation, ingestion or through a skin abrasion or injection site. Anthrax does not typically spread directly between people but is commonly found in those who work with animals or animal products. Many workers who deal with wool and animal hides are routinely exposed to low levels of anthrax spores, although most exposure levels are not sufficient to develop infections. However, vaccination is available for those who are at high risk and immunization of animals is also recommended in areas where previous outbreaks have occurred.

Although a rare disease, human anthrax occurs mostly in Africa, Asia and Southern Europe with around 2000 cases occurring annually. The disease is relatively uncommon in Northern Europe and North America. Of the various types of anthrax, the cutaneous form is the most common, occurring in greater than 90% of all anthrax cases. This form presents as a boil-like lesion that eventually forms an ulcer with a black centre (Figure 1). However, cutaneous anthrax is the least dangerous form with a low mortality if treated but increases up to 20% mortality if left untreated. Respiratory anthrax is

relatively rare but has a higher mortality even when treated. In respiratory disease, the lymph nodes in the chest become infected first before spreading to the alveoli in the lungs (Figure 2).



**Figure 1. Cutaneous anthrax**

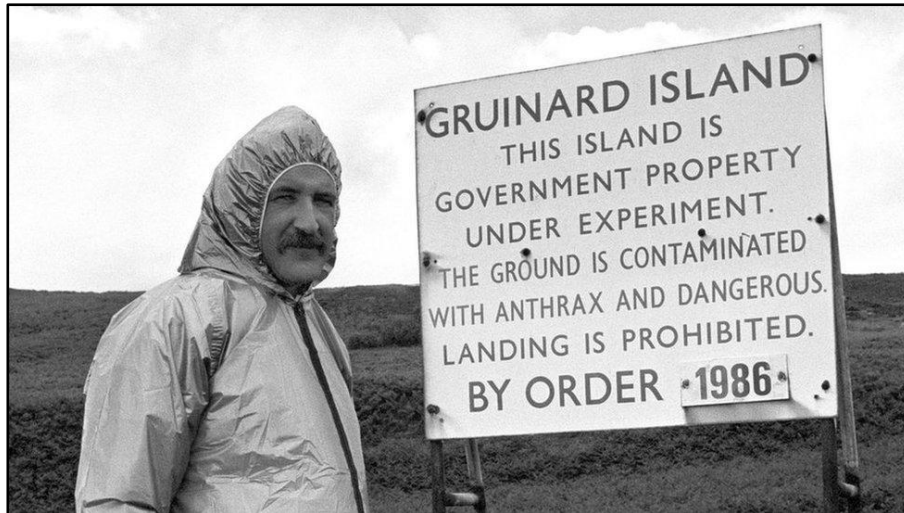


**Figure 2. Respiratory anthrax**

Symptoms include high fever, extreme shortage of breath and rapid death occurring within days in fatal cases. Ingesting anthrax spores through the consumption of infected meat causes gastrointestinal infection and this is the rarest form of anthrax. Lesions can be found in the intestines and in the mouth and throat of those infected. The bacterium can spread to the bloodstream and throughout the body, while continuing to make toxins. These infections can be treated, but usually result in fatality rates of up to 60%, depending upon how soon treatment commences.

### **Anthrax and biological warfare**

Historically, anthrax spores have been used as a weapon of war and as far back as 1916, it was reported that Nordic rebels in Finland used anthrax against the Imperial Russian Army. During the 1930s, anthrax was tested by the Japanese and involved the intentional infection of prisoners of war with thousands of them dying as a result. During the Second World War, the Vollum strain of anthrax was developed as a biological weapon and used during the British bioweapons trial of 1942 that took place on the Scottish island of Gruinard (Figure 3). The island only become safe in 1990 following decontamination by the Ministry of Defence. Although it has been used to develop vaccines, the Vollum strain is still highly dangerous and is thought to have been the strain in possession of the Iraqi government during the Gulf war.



**Figure 3. Gruinard Island located off the north west coast of Scotland**

In modern times, many countries have signed the treaty of the Biological Weapons Convention banning the production, development and stockpiling of toxic weapons. However, despite signing the 1972 agreement, the Soviet government had an active programme and as a result of an accidental release of anthrax from a biological weapons complex near Sverdlovsk in 1979, many people died. A 'battle strain' of anthrax was also later developed by a former Soviet bioweapons designer. Known as Strain 836, it was reported as being the most virulent and vicious strain of anthrax known to man. However, one strain that has probably received the most news coverage is the virulent Ames strain. This strain was used in the 2001 anthrax attacks in the United States that occurred within weeks of the disaster on September 11<sup>th</sup> at the World Trade Centre. In this attack, seven letters containing the Ames strain of anthrax were sent to several media outlets and politicians. Five people died and 22 more were infected as a result. Some years later, the US Department of Justice proclaimed that Bruce Ivins, a senior biodefence researcher employed by the United States government was the perpetrator. More recently, in May 2015, the Pentagon acknowledged that samples of live anthrax of the Ames strain had been sent from a laboratory in Utah to another laboratory in Maryland. These samples had eventually been distributed to laboratories in all 50 states and to several overseas countries. Although no deaths or serious illnesses had been reported in shipping anthrax to laboratories for testing, many civilians and military personnel were treated with antibiotics as a precaution. Because of its virulence, the Ames strain is used as the gold standard in the development and testing of anthrax vaccines in the United States.

Anthrax is difficult to control and outbreaks can be very difficult to predict. As an occupational disease, anthrax can affect butchers, farmers and veterinarians who are likely to become in contact with or handle infected animals or carcasses. Industrial exposure may also lead to inhalation of the spores from aerosols produced in the processing of animal hides, hair and wool. Laboratory workers too, are also at risk when working with samples that are known to contain anthrax spores. Although it occurs very rarely in developed countries, the use of anthrax spores to intentionally cause human suffering has heightened the awareness of it. If recognized early, cutaneous anthrax is readily treatable with antibiotics. However, anthrax disease caused by inhalation or ingestion are associated with a high mortality rate even with appropriate antibiotics and modern supportive care.

### **Further reading**

<https://www.cdc.gov/anthrax/>

<https://www.cdc.gov/anthrax/bioterrorism/index.html>

<https://www.mayoclinic.org/diseases-conditions/anthrax/symptoms-causes/syc-20356203>

<https://www.who.int/csr/disease/Anthrax/anthraxfaq/en/>

[https://en.wikipedia.org/wiki/Gruinard\\_Island](https://en.wikipedia.org/wiki/Gruinard_Island)

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