Anthrax Essay, Research Paper

ANTHRAX AS A BIOLOGICAL WEAPON

An Overview of Biological Warfare

The purpose of this paper is to examine the nature of biological warfare and it s agents. The main focus will be on Anthrax bacteria as a biological weapon and the effects it has on the bodily functions.

A History of Biological Warfare

Before we get into the various aspects of Biological warfare it is important to understand exactly what it is. According to the website designed by students in Chem 450 at Cal Poly (www.calpoly.edu/ drjones/chemwarf.html) Biological Warfare is the use of disease to harm or kill an adversary s military forces, population, food, and livestock. This includes any living (non-living virus) microorganism or bioactive substance that is produced by a microorganism and can be delivered by conventional warhead or civilian means. The use of Biological Warfare has been documented as early as 1346, at Kaffa the bodies of plague infested Tartars were thrown over the walls of the besieged city. The greatest advancements in biological warfare have come in the 20th century, starting just prior to WWI. Although most of the advanced countries were experimenting and developing biological agents for use as weapons, there were two documented tests that helped open the eyes of the world to the threat of biological weapons.

At the end of WW II Britain was conducting extensive tests on anthrax bacteria and its effective infecting range when delivered with a conventional warhead. The military decided to conduct tests on Gruinard Island. The isolated island was located far off the coast of Scotland and was thought to be a good spot to test while avoiding any contamination of the mainland. The experiments were conducted and shortly thereafter sheep and cattle started dying from the disease on the mainland. The authorities tried to decontaminate the island by setting fires and bleaching it, unfortunately the measures were ineffective. The spores embedded themselves in the soil and as a result decontamination was impossible. There are still minor outbreaks on the coast of Scotland when birds returning from the island transmit the disease to livestock. Another outbreak of Anthrax occurred in the former Soviet Union in 1979. After an accident at a research facility, a large outbreak of Anthrax was reported in the countryside, downwind of the plant.

Until this point the Soviets were not known to have an extensive bio-warfare program. This triggered the Western countries and it s allies to start upgrading their defensive capabilities (www.calpoly.edu/ drjones/chemwarf.html). Throughout history there have been many other incidences where biological weapons have been tested or used on the general population. The majority of these cases have occurred in the past 75 years. The threat of biological warfare is no longer a far-fetched fantasy, it is a reality.

Anthrax

Bacillus anthracis is a naturally occurring spore forming bacteria. It is this bacterium that is responsible for the various forms of Anthrax found in both humans and animals. Bacillus anthracis has a protective protein coat that allows it to survive for decades at a time where ever it may be found, e.g. soil, air, or in a laboratory. Once inside the body the bacteria have an incubation period of 1 to 6 days. There are three types of anthrax humans can get, cutaneous anthrax, inhalation anthrax, and gastrointestinal anthrax.

Cutaneous anthrax is the result of the bacterium entering the body through a break in the skin layer. The symptoms of cutaneous anthrax may vary slightly from case to case but the most common sign of infection is an itchy bump at the site of infection. The sore continues to grow until it is roughly 2-3 cm in diameter with the center portion decaying into black tissue. Cutaneous anthrax is usually treated successfully with antibiotics, according to Science magazine only 15% of reported cases have resulted in death.

Gastrointestinal anthrax occurs when a human consumes the meat of an infected animal. Symptoms start to show within 8-10 hours; they range from mild stomach discomfort to severe diarrhea, fever and vomiting of blood. Gastrointestinal anthrax is the rarest form of the disease because infected livestock will usually perish before they are used for consumption.

The survival rate depends on how early the infection is diagnosed. Antibiotics are the most effective treatment, death results in 25%-60% of cases (Arnot Ogden Medical Center).

Inhalation anthrax is the deadliest form of anthrax known to man, it is this form of anthrax that is most likely to be utilized in a bio-weapons attack.

Inhalation anthrax occurs when a person inhales the bacillus anthracis spores into their lungs. The bacterium then travels to the lymph nodes and begins multiplying. Once in the lymph nodes the bacterium will spread through the entire body and the lungs are the first vital organs to succumb to the toxins produced by the bacteria. The toxins will cause bleeding in the lungs and they fill up with fluid very rapidly, death can result in as little as 24 hrs. It is extremely important to note that it is the toxins produced by the bacteria that play the largest role in destroying the body. Toward the final stages of the disease the amount of toxin in the blood stream is almost the same as the concentration of organisms in the blood. The symptoms of inhalation anthrax are quite similar to those of pneumonia in the initial stages of the infection (mild chest discomfort, fever coughing) as the infection becomes more acute there will be severe difficulty breathing followed by total respiratory failure. Inhalation anthrax is extremely lethal and death results in almost every case. Antibiotics may postpone death if treatment is started early but by the time the symptoms start showing there is little that can be done to kill the bacterium.

Anthrax as a Biological Weapon

If the bacillus anthracis is to be harnessed as a biological weapon there must be an effective mode of dispersal. Aircraft sprayers (crop dusters), ballistic missiles, and hand held aerosols are all able to disperse anthrax spores with great efficiency. The main focus of an attack would be to cause inhalation anthrax because of the high fatalities that would occur. The bacteria would have to be grown, dried and ground into powder before it could be used as an aerosol . There are some big advantages and disadvantages of using anthrax as a biological weapon.

Advantages of Using Anthrax as a Weapon of War

According to the American Department of Defense the amount of the agent necessary to kill millions of people could be less than 100 kilograms (depending on the population in the area of dispersal). The cost of producing this amount anthrax or any other biological weapon is very small, less than $2000. The production and assembly of anthrax into a biological weapon is not that difficult. Another advantage of using anthrax is that any country or small group of terrorists with an advanced knowledge of pharmaceutical operations could conceivably grow enough bacteria in a small lab to kill the population of an entire country. This type of operation would be extremely hard to detect because the equipment necessary to carry out the procedure is identical to the equipment found in every pharmaceutical lab. A distinct advantage of using an anthrax attack versus a conventional attack (nuclear, infantry) is the number of people needed to carry out the operation. A conventional attack would require the organization of a large number of people whereas a single person could carry out a biological attack. When a conventional attack occurs the attacking forces destroy enemy forces, buildings, resources, and industries. This is not the case in a biological attack, the opposition will lose all of its armed forces and civilian population while buildings, and resources remain intact. This is a very appealing scenario if you want to take over another country. If an anthrax out break was to occur it would be very difficult to determine who was responsible for the outbreak, if anyone can be blamed at all. Unfortunately anthrax occurs naturally in regions all around the world. This makes it hard for one country to blame another country or group for the outbreak. The greatest advantage anthrax has over other potential biological weapons is the ability for it to go undetected until it s too late. Anthrax spores are, colourless, odourless, and tasteless and are totally undetectable when dispensed with the aid of an aerosol device. By the time a population realized it has been exposed to the airborne spores it is too late to treat them. These factors make anthrax an extremely appealing biological weapon for small countries or terrorist groups that want to inflict damage on a more powerful adversary

Disadvantages of Using Anthrax as a Biological Weapon

When anthrax is employed as a biological weapon it must dispersed in the air to be deemed truly effective. The air borne spores can move unpredictably and it is hard to say exactly where they will travel. This is a major disadvantage because an attacking army could potentially infect its own troops if wind conditions weren t favourable. When using anthrax spores in particular you are dealing with bacteria that has a life span of decades, it is not practical to take over an area with anthrax and not be able to get rid of it. A major downfall of bio-weapons is the inability to effectively choose a target. During most army operations the main targets are military structures and personnel, a missile has a known capability and range therefore attacks can be precise and well directed. When using bio-weapons the range of spread can not be effectively monitored. Anthrax will not differentiate between military personnel and innocent civilians. The nature of inhalation anthrax makes it an effective killer but it is not as effective as other diseases e.g. bubonic plague, because of the way it is transmitted. Inhalation Anthrax is not contagious; it is safe to work with infected individuals without fear of contamination. This is a disadvantage because the bacteria will not proliferate; the amount of anthrax dispersed in the air is roughly the same amount you can expect to find after dispersal.

The disadvantages of anthrax as a weapon are unfortunately outweighed by the advantages especially since some of the disadvantages are only moral issues.

Why is Anthrax one of the greatest threats?

In recent years the threat of nuclear war has become less significant, the countries that are advanced enough to have nuclear capabilities have imposed serious restrictions on their use. The devastation that nuclear bombs possess has been realized and their use is considered only as a last line of defense. However the threat of bio-terrorism and biological warfare is on the rise. Anthrax in particular has been thought of as the weapon of choice for any group or country considering a biological attack. The question is why? Anthrax levels the playing field for countries and organizations that have neither the money, manpower nor technology to support a nuclear program or similar large-scale operation. With biological weapons you have a device capable or doing as much damage as a nuclear weapon at a fraction of the cost. According to a website published by Johns Hopkins University the number of countries that have active bio-warfare programs has almost doubled since 1989. Anthrax is one of the top choices for a bio-weapon because it isn t that difficult to obtain. It occurs naturally in some areas of the world and it can be isolated and grown from contaminated tissue or soil samples. Similar bacteria such as smallpox and bubonic plague are just as deadly but are harder to isolate. The only known stockpiles of smallpox and plague bacteria are held by the Russian and United States governments. Once a sample of the bacteria is obtained it could be reproduced quite easily by an undergraduate student. The students in Dr. Jones biochemistry class at Cal Poly published a website that outlined the procedure for isolating and reproducing the bacteria. The steps were almost exactly the same as a lab they had just completed to isolate a different kind of bacteria. The steps are as follows:

1.Select a source of protein you want a mass quantity of

2.Isolate and purify total RNA

3. Make a cDNA copy using Reverse Transcriptase

4.Amplify the cDNA using PCR

5. Clone the fragment by inserting into a plasmid and transforming an E. coli 6.Express protein and purify protein

If information on these procedures is so easily accessible it is only a matter of time before someone uses it to create a weapon of destruction. The preceding points were only to illustrate the probability of a biological attack with Anthrax spores vs. another agent. In no way is Anthrax the only bio-warfare threat, there are many agents that are as dangerous as anthrax or worse.

Prevention of Anthrax

As outlined earlier, most forms of anthrax are treatable with antibiotics. Inhalation anthrax is not. In regions were anthrax is found naturally animals can be inoculated against the disease. There is also a vaccine for humans, which has been reported to be 95% effective by the U.S. Department of Defense. It is now mandatory for all U.S. military personnel to receive the vaccine because of the risk of anthrax being deployed as a biological weapon. The vaccine is available for people who may be working with the bacteria on a daily basis e.g. veterinarians, butchers. Unfortunately the vaccine is not made available to the general public so civilians must take their own precautions to avoid becoming infected. The main concern for a civilian is to avoid breathing in the harmful endospores. A gas mask or any other facial covering would decrease the chances of inhaling anthrax. Remaining indoors will not help; the spores are so small they will easily enter the smallest cracks in a building. A rubber suit or any full body covering can also decrease chances of contacting the bacteria, although without a proper facemask any suit is useless. The best advice is to always be aware of your surroundings, and take note of suspicious activity. If you feel that you may have been exposed to some form of BW agent antibiotic treatment should be started immediately. Early treatment of anthrax cases greatly improves chances of survival.

Although the threat of biological warfare exists it is not necessary to become paranoid about the subject. It would benefit people to read up on the subject and become familiar with the various agents of bio-warfare. A basic knowledge of what to do in case of a possible outbreak of a disease may just save your life. Although this application of biotechnology is very negative there are many other forms of biotechnology that are making this world a better place to live.

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