In Cipro We Trust

Michael English
Class Standing: Senior
Major: Political Science
E-mail: mike_heidi_english@hotmail.com

After Tom Brokaw was the target of a bioterrorist attack he quipped, "In Cipro we trust." Cipro is a powerful antibiotic used to fight anthrax and many other bacterial infections. Cipro was developed from quinolone, an anti-malarial agent discovered in the 1940s. Drugs derived from quinolone fight bacteria by binding topoisomerase, sometimes called DNA Gyrase. Cipro has many aspects that make it good at fighting bacteria. The carboxylic acid (COOH) at Carbon 3, the Oxygen at Carbon 4 and the Fluorine at Carbon 6 all make the drug bind the bacterial topoisomerase more tightly, making the drug more efficient.

In 1990 when the U.S. began operation Desert Storm, military experts suspected Saddam Hussein of having a large biological weapons stockpile, including Anthrax. At that time many bacterial strains had developed resistance to traditional antibiotics like Penicillin. Bayer, a German pharmaceutical company developed Cipro in 1981. The FDA didn't approve the drug for use until 1987. Because Cipro was a new drug the chance of resistant bacterial strains was extremely low. The government ordered 30 million tablet of Cipro for soldiers serving in the Persian Gulf area.

When Anthrax infects a host the host's immune system reacts quickly sending bacteria forms a protective spore. The bacterial spore is able to withstand the immune cell attack. The immune cell carries the spore to a lymph node where the bacteria escapes and begins spreading.

Several antibiotics are effective at killing the Anthrax bacteria. The problem, however, is that while the antibiotics are killing Anthrax the bacteria is releasing toxins that can kill the host even after the bacteria is dead. The bacteria's toxins are much worse than the bacteria itself.

Anthrax has three toxins: PA, EF and LF. PA binds to the cell membrane and forms a polymer consisting of seven PA toxins. Then either EF or LF binds to the PA polymer and the toxins are endocytosed into the cell and sent to the cell's lysosome. The lysosome has an acidic environment to degrade foreign proteins. Once the PA polymer enters this acidic environment it undergoes a conformational change forming a pore releasing the EF or LF Factor into the cell's cytoplasm.

Fortunately Cipro and other drugs are still great antibiotics for many diseases, including Anthrax, but like most antibiotics bacteria become resistant at an incredibly high rate. Many Cipro resistant strains of bacteria have been discovered. As more and more bacteria become resistant to antibiotics alternative treatments will become necessary.

Geneticists have discovered an even better defense against Anthrax. Geneticists caused a mutation in the gene encoding the PA toxin. The mutant toxin is able to bind functional bacterial PA toxin. Any PA polymer that contains just one mutant PA toxin is dysfunctional. With the PA polymer not working the LF and EF toxins are unable to enter the cell. Rats infected with Anthrax and injected with mutant PA toxins all survived the infection. This type of treatment may be