Bacteriophages vs antibiotics

Health & Medicine

Bacteriophages are actually viruses highly specialized to attack bacterial cells while doing no harm to animal cells. When a phage discovers a bacterium to which it possesses the correct key—that is, suitable receptors on the bacterial cell to which the phage can attach its tentacle-like extensions—then the phage will inject its hereditary DNA into the bacteria cell. Taking over the bacterial cell's biochemical apparatus, the phage produces hundreds of phage copies, rupturing the cell. As the victim cell dies, the released phage copies attack any remaining bacterial cells like a pack of hungry wolves (Reidel).

Advantages The advantages of the therapy are obvious. Bacteriophages are very specific parasites and, unlike antibiotics, do not damage the useful bacteria that live in and on the body. Phages are " intelligent" medicine: They increase just where they are needed, while antibiotics often do not get to where they are needed. Once all phage-susceptible bacteria have been killed, phages are eliminated from the body. The most apparent benefit of phage therapy is that although bacteria are able to develop resistance to phages the resistance is much easier to overcome.

The reason behind this is that phages replicate and undergo natural selection and have probably been infecting bacteria since the beginning of life on this planet. Although bacteria evolve at a fast rate, so too will phages. Bacteria are most likely to modify the molecule that the phage targets, which is usually a bacterial receptor. In response to this modification phages will evolve in such a way that counteracts this change, thus allowing them to continue targeting bacteria and causing cell lysis.

As a consequence phage therapy is likely to be devoid of the problems similar to antibiotic resistance. Increasing evidence shows the ability of phages to travel to a required site — including the brain, where the blood brain barrier can be crossed — and multiply in the presence of an appropriate bacterial host, to combat problems such as meningitis. However the patient's immune system can, in some cases mount an immune response to the phage (2 out of 44 patients in a Polish trial (Carson)).

Development and production is faster than antibiotics, on condition that the required recognition molecules are known. Disadvantages According to Reidel, the phages' high specificity, with which they look for their bacterial victims, is at the same time also their therapeutic Achilles' heel. Therefore, either a cocktail containing many different types of phages must be developed by the infection control specialist, or a phage effective against the specific pathogen of each patient must be custom-made through detailed microbiological analytical work.

Western regulatory authorities tend to loathe recognizing such manually manufactured anti-infective agents as medicines, which explains why currently phage therapy is routinely only available at phage therapy centers in Georgia (part of former Russia), Europe and Poland. However, the Wound Care Center in Lubbock, Texas, has started to treat patients. For chronic infections due to multi-resistant pathogens, phage therapy could become a kind of miracle medicine. Wikipedia condends that Bacteriophage therapy is generally very safe; however fevers can occur with phage treatment.

This is thought to be caused by endotoxins released by the bacteria within the patient after they have been lysed by the phage (Herxheimer Reaction),

of course this can happen with antibiotics also. Additionally care has to be performed in manufacture that the phage medium isn't contaminated with bacterial fragments and endotoxins from the production process. It is beneficial if testing on animals is performed to ensure safety. Lysogenic bacteriophages are also thought to be risky, and are now seldom used therapeutically.

These viruses can act as a way for bacteria to exchange DNA, and this can help spread antibiotic resistance or even, theoretically, can make the bacteria pathogenic. To work, the virus has to reach the site of the bacteria, and unlike antibiotics, viruses do not necessarily reach the same places that bacteria can reach. Finally, some non therapeutic (lysogenic) phages transfer genes between bacteria that code for pathogenicity, notable in cholera. This makes it important to identify the phages being used to show that they are not harmful ones. What are ANTIBIOTICS?

An antibiotic, according to Wikipedia, is a drug that kills or prevents the growth of bacteria. They have no effect against viruses or fungal infections. Antibiotics are one class of antimicrobials, a larger group which also includes anti-viral, anti-fungal, and anti-parasitic drugs. They are relatively harmless to the host, and therefore can be used to treat infections. The term, coined by Selman Waksman, originally described only those formulations derived from living organisms, in contrast to " chemotherapeutic agents", which are purely synthetic.

Nowadays the term " antibiotic" is also applied to synthetic antimicrobials, such as the sulfa drugs. Antibiotics are generally small molecules with a molecular weight less than 2000 Da. They are not enzymes. Some antibiotics

have been derived from mold, for example the penicillin class. Volume 4 of How Products Are Made says that antibiotics differ chemically so it is understandable that they also differ in the types of infections they cure and the ways in which they cure them. Certain antibiotics destroy bacteria by affecting the structure of their cells. This can occur in one of two ways.

First, the antibiotic can weaken the cell walls of the infectious bacteria, which causes them to burst. Second, antibiotics can cause the contents of the bacterial cells to leak out by damaging the cell membranes. One other way in which antibiotics function is to interfere with the bacteria's metabolism. Some antibiotics such as tetracycline and erythromycin interfere with protein synthesis. Antibiotics like rifampicin inhibit nucleic acid biosynthesis. Still other antibiotics, such as sulfonamide or trimethoprim have a general blocking effect on cell metabolism. Advantages

It is estimated that the average duration of many infectious diseases and the severity of certain others have decreased significantly since the introduction of antibiotic therapy. The dramatic drop in mortality rates for such dreaded diseases as meningitis, tuberculosis, and septicemia offers striking evidence of the effectiveness of these agents. Bacterial pneumonia, bacterial endocarditis, typhoid fever, and certain sexually transmitted diseases are also amenable to treatment with antibiotics. So are infections that often follow viral or neoplastic diseases, even though the original illness may not respond to antibiotic therapy.

Antibiotics in small amounts are widely used as feed supplements to stimulate growth of livestock and poultry. They probably act by inhibiting organisms responsible for low-grade infections and by reducing intestinal

epithelial inflammation. In cattle, sheep, and swine, antibiotics are effective against economically important diseases. The use of antibiotics in dogs and cats closely resembles their use in human medical practice. In fish farms, antibiotics are usually added to thefoodor applied to the fish by bathing.

The incidence of infections in fish, and animals in general, may be reduced by the use of disease-resistant stock, better hygiene, and better diet. Although effective against many microorganisms causing disease in plants, antibiotics are not widely used to control crop and plant diseases. Some of the limiting factors are instability of the antibiotic under field conditions, the possibility of harmful residues, and expense. Nevertheless, antibiotic control of some crop pathogens is being practiced, as is true of the rice blast in Japan, for example (Scienceand Tech). Disadvantages

Some individuals may have allergic reactions to antibiotics. If symptoms of an allergic reaction (such as rash, shortness of breath, swelling of the face and neck), severe diarrhea, or abdominal cramping occur, the antibiotic should be stopped and the individual should seek medical advice. Because antibiotics can affect bacteria that are beneficial, as well as those that are harmful, women may become susceptible to infections by fungi when taking antibiotics. Vaginal itching or discharge may be symptoms of such infections. All patients may develop oral fungal infections of the mouth, indicated by white plaques in the mouth.

Injected antibiotics may result in irritation, pain, tenderness, or swelling in the vein used for injection. It is a common assertion that some antibiotics can interfere with the efficiency of birth control pills. Although there remain few known cases of complication, the majority of antibiotics do not interfere

with contraception, despite widespread misinformation to the contrary (Gale). And there’s also what is known as Antibiotic Resistance. Wikipedia says that Antibiotic Resistance is the ability of a micro-organism to withstand the effects of an antibiotic. It is a specific type of drug resistance.

Antibiotic resistance evolves naturally via natural selection through random mutation, but it could also be engineered for the purpose of creating bio-weapons. SOS response of low-fidelity polymerases can also cause mutation via a process known as programmed evolution. Once such a gene is generated, bacteria can then transfer the genetic information in a horizontal fashion (between individuals) by plasmid exchange. If a bacterium carries several resistance genes, it is called multiresistant or, informally, a superbug. Antibiotic resistance can also be introduced artificially into a micro-organism through transformation protocols.

This can be a useful way of implanting artificial genes into the micro-organism. Phages Vs Antibiotics (A Summary) Bacteriophages are great because: • Bacteria evolve at a fast rate, but so do phages. This makes Bacteriophages devoid of problems similar to antibiotic resistance. • Bacteriophages are very specific parasites and, unlike antibiotics, do not damage the useful bacteria that live in and on the body. Phages are " intelligent" medicine: They increase just where they are needed, while antibiotics often do not get to where they are needed.

• Development and production is faster than antibiotics. • The recovery rate was discovered to be faster in some cases—a tribute to the speed with which the phage multiplied and overcame its host bacteria. • Incidents of misuse are relatively unknown. Antibiotics are great because: • The use of

antibiotics on domesticated animals, closely resemble its use in human medicine thus greatly benefiting them. • Phages work best when in direct contact with the infection, so they are best applied directly to an open wound.

This is rarely applicable in the current clinical setting where infections occur systemically. • Unlike Phages, which are hardly ever used for therapeutic reasons, antibiotics reduce the incidence of both suppurative and non-suppurative complications of sore throat. A new study from Holland has confirmed that antibiotics protect against quinsy. • Lysogenic bacteriophages are thought to be risky. These viruses can act as a way for bacteria to exchange DNA, and this can help spread antibiotic resistance or even, theoretically, can make the bacteria pathogenic.

To work, the virus has to reach the site of the bacteria, and unlike antibiotics, viruses do not necessarily reach the same places that bacteria can reach. • Antibiotics are more readily available because phages have high specifity and require detailed microbiological analytical work. Conclusion The research is still ongoing. Though the odds are in favor of Bacteriophages becoming more common, there have been no large clinical trials to test their efficacy. This therapy today essentially exists only in some Eastern European countries, including Georgia and Poland.

But largely because of the growing concern over antibiotic resistance, a lot more people in the medical field are interested in pursuing bacteriophages as an alternative to antibiotics on a large scale. W O R K S C I T E D 1. Reidel, William. “ Book Review: Viruses vs. Superbugs: A Solution to the Antibiotics Crisis? ” Epoch Times. (6 May, 2006). 14 April, 2007. http://en. epochtimes.

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