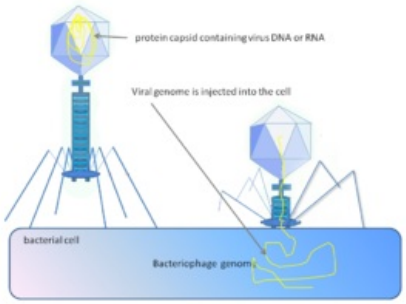
Bacteriophage therapy

Bacteriophage (abbreviated **phage**) is a virus that attacks exclusively bacteria. It infects the bacterial cell and multiplies in it, after which hundreds of new virions leave the bacterium, which also kills it. Bacteriophages thus multiply exponentially at the site of infection. They do not have the ability to attack an eukaryotic cell (e.g. human)because the receptors on the surface of this cell to which the phages bind do not tell them anything (unlike the receptors on the surface of the bacterial cell, which they specifically recognize). Phages have been a natural part of the environment for hundreds of millions of years and you don´t mind. This can be used in therapy. Bacteriophage therapy is an **alternative to failing antibiotics**.

History of bacteriophage therapy

It all started with water from the Ganges. At the end of the 19th century, *Ernest Hankin* discovered that her water had antibacterial effects - specifically against Cholera. Not surprisingly, bacteriophages are abundant where their host is. Ten or fifteen years before *Alexander Fleming* discovered the bactericidal effects of fungi and gave the world its first antibiotic – penicilin (1928), *Félix d´Hérelle* and *Fréderick Twort* independently observed bacterial cultures at the site of bacterial lysis. D´Hérelle was convinced that it was a virus but for him then an invisible unit. He and his wife named him bacteriophage (bacterial eater). It was he who, for the first time, specifically tested bacteriophages for therapy. It was a boy suffering from dysentery caused by bacteria of the genus *Shigella*. Other species of bacteriophages specific for the treatment of plague or cholerahave been successful and isolated. Together with their Georgian colleague microbiologist *Giorgem Eliavou* they founded the Eliava Institute in Tbilisi, Georgia, which, among other things, dealt with phage treatment.

However, phagotherapy has entered the background due to the rocketing rise of antibiotics which are non-specific and therefore cover a whole range of diseases. In the beginning, it was considered a panacea. And yet a chemical is more attractive than a virus solution. bacteriophages remained in the eastern bloc with their center in Tbilisi. During World War II, they were used in combat camps to treat epidemics of cholera, gangrene, shigellosis. It was a financially very interesting and simple treatment. In the 1980s, they also began phagotherapy at the Academy of Sciences in Warsaw in Poland, successfully treating diseases caused by antibiotic-resistant strains. Although the results looked very positive, even miraculous, the then rigorous socialist scientific approach and isolation from the rest of the world did not allow for a more vigorous promotion of phagotherapy. Today, therapy is possible in two places - in Tbilisi (Georgia) [1] and in Wroclaw (Poland) [2] (experimental character). More and more scientists are starting to focus on bacteriophages and despite strict drug guidelines, some products such as antibacterial patches or bacteriophage wound dressings are also coming to us.



Bacteriophage bacterial infection

Comparison of phagotherapy and antibiotics

	Bacteriophage therapy (BF)	Antibiotics (ATB)
Specificity	BF attacks only a given pathogen they are specific to the given bacteria. In this way, they avoid the natural intestinal flora. On the other hand, an analysis must be performed before treatment and the correct virus selected from the phage bank . It is, of course, inert to human eukaryotic cells.	ATBs are non-specific, broad-spectrum ATBs destroy the intestinal flora. On the other hand, they can act quickly in the event of an acute infection and a threat to life, when there is no time to identify the cause of the disease.
Side effect	We eat BF in large quantities every day, passing through the body unnoticed. During therapy, they multiply only at the site of their specific bacteria. So all you have to do is give a small dose, which will find the bearing where it operates. Then it disappears from the body. In the past, temperate phages were behind the failure of treatment - they stored their genome in the bacterium and multiplied with it, they did not kill it. Transduction and patogenity could also occur . The solution is to use exclusively virulent phages that do not enter the lysogenic cycle and quickly kill the bacteria lytic cycle. As with ATB treatment, a side effect may be a reaction to endotoxin from dead bacteria.	ATBs are excreted from the body as foreign substances. They should be delivered to the body regularly during treatment. There are allergic reaction to some ATBs, of course to bacterial endotoxin and digestive problems are a complication.
Resistance	BFs are effective in treating severe infections caused by multi-resistant strains of bacteria for which all ATBs are already short - such as MRSA. The bacteria, of course, develop resistance to BF. But they are not behind and are changing so that even new bacteria can infect. It is the natural development of the host and parasite that maintains balance in nature.	Increasing bacterial resistance to ATB is becoming a major problem. There are resistant strains of bacteria in the world against which we do not have effective ATB. The development of new ATBs ceases to be exhausted.
Production / price	BFs are natural, need to be purified, and can multiply very well on host bacteria (several thousand units come out of a single infected bacterium in a few hours). The cost is very low. There are phage banks (eg the most comprehensive in Tibilisi) that need to be replenished. Phages can be genetically modified (eg, to light up when they attack a bacterium, which will help localize the infection). Possibility of application in developing countries.	Launching a new ATB is a very expensive and long process. There is certainly pressure from the pharmaceutical industry to prefer expensive ATBs over simple BFs. At present, the research is exhausted and no new way of acting ATB is being sought.
Efficiency	Studies from the Soviet bloc do not meet scientific standards. But the results are very promising - whether in the treatment of the plague in Egypt, cholera in India or the epidemic of dysentery in Soviet field hospitals. Patients from all over the world have been coming to Tibilisi for several decades and often find successful treatment for infections for which all ATBs are short (gangrene, MRSA and others).	Efficiancy has been proven in ATB but there is a growing problem of resistance. Common side effects.
Use	There are no pharmacological studies, the virus is on the border between living and non-living. Commissioning with normal regulations will be very difficult. BF patches and similar preparations are already appearing.	ATB prescribing is a standard procedure.

Links

Related articles

- Bacteriophage
- Reproduction of DNA viruses

Source

- Will the era of antibiotics end, will they be replaced by bacteriophages? (https://www.scienceworld.cz/biologie/skonci-era-antibiotik-nahradi-je-bakteriofagy-6680/)

Reference

1. http://91.239.206.16/~eliavainst/
2. https://www.iitd.pan.wroc.pl/en/Phages/

References

- HANA, ŠPANIELOVÁ. Bacteriophage therapy - utopia or reality?. *Universe.* 2006/12, y. 85, no. 12, p. 750, ISSN 1214-4029.