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the cover Jacopo Bonotto

How can “good viruses” affect our health

Although it is difficult to talk about “good viruses” in a pandemic and the many infections caused by the SARS-CoV-2 virus, there is growing evidence about how beneficial some viruses can be to our health. Such “good viruses” are bacteriophages (a direct translation would be bacteria-eaters). They are found wherever bacteria are found, including in our bodies. Bacteriophages (phages for short) are viruses that only infect bacteria, while human and animal cells are not affected. Usually once a phage attaches itself to a bacterium, it injects its genetic material into the bacterium and subverts the molecular machinery of the bacterium consequently many new phages are formed in the bacterium. When the bacterium is no longer useful, the phages simply degrade it and release many new phages into the environment that can infect new bacteria (Figure 1).

Bacteriophages were already known at the beginning of the last century, when some bacterial infections were treated with them. With the discovery of antibiotics, bacteriophages became obsolete in America and Western Europe. Antibiotics revolutionised medicine by successfully treating various bacterial infections. However, the increasing resistance of bacteria to antibiotics we have seen in recent years is a major global threat and a cause for concern, according to the World Health Organisation, with no new antibiotics in sight. Research in the UK suggests that we are facing a “pre-antibiotic” era. According to this, over 10 million people could die from bacterial infections caused by antibiotic-resistant bacteria by 2050. That is why today we are increasingly pinning our hopes on the use of bacteriophages as natural enemies of bacteria.

Why are we investigating the use of bacteriophages in the Orthopaedic Research Group at the Valdoltra Orthopaedic Hospital (OBV)? OBV is the leading orthopaedic hospital in Slovenia, where we perform about 5000 surgical procedures on the skeletal system of the musculoskeletal system every year. Of these, we insert over 2500 joint prostheses every year. In Slovenia and worldwide, infections occur in about 2-3% of patients who have had a joint prosthesis inserted. Infections of prostheses with bacteria resistant to one or even several antibiotics are also becoming more common in the OBV. In these patients, treatment is difficult and often unpredictable.

We believe that bacteriophages will play an important role in the treatment of such infections. With our research, we want to expand our knowledge of bacteriophages and get as close as possible to the real patient situation through experiments in the laboratory and on animal models, so that we can translate this knowledge into clinical practise to treat our patients. In this research, we pool our knowledge with research groups in Slovenia and abroad (Figure 2). We showed years ago that bacteriophages are not only useful for treating bacterial infections, but can also be useful in diagnosing prosthetic joint infections.

Therefore, as the lead partner of the Interreg Italy-Slovenia

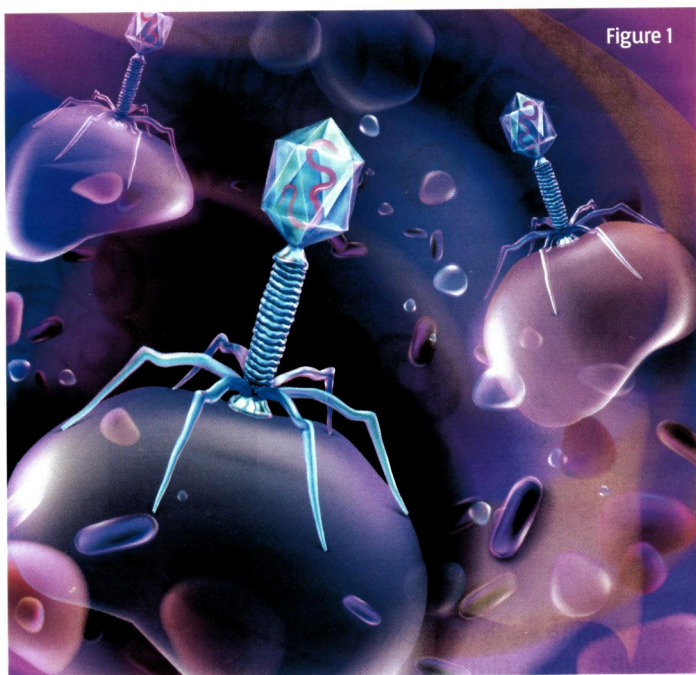


Figure 1 -Bacteriophages are viruses that infect bacteria but do not affect human cells



Figure 2 - Logos: the IMBI project and the project partners

cross-border cooperation project “Diagnosis of prosthetic joint infections with innovative methods based on bacteriophages”, we have brought together leading experts from both sides of the border under the acronym IMBI to identify the most effective methods for diagnosing bacterial infections using bacteriophages. Besides OBV, the project is led and steered by two Slovenian partners, the Faculty of Chemistry and Chemical Technology at the University of Ljubljana and JAFRAL d.o.o, and two Italian partners, ICGEB and Dott. Dino Paladin. The results of the joint research

have shown that bacteriophages can be used very efficiently to diagnose bacterial infections, even when classical microbiological diagnostics fail, and that bacteriophage-based methods allow us to identify the infectious agent very quickly (Figure 2).

The recent discovery that different proteins can be attached to the envelope of bacteriophages by a special ‘phage display’ technology offers unprecedented opportunities for the use of such recombinant bacteriophages, especially for the discovery of new drugs that will play an important role in the treatment of patients. At OBV we are researching the production of vaccines against some of the deadliest diseases, such as malignant melanoma, using the phage display technology.

At OBV we know that research is the key to medical progress. Through our research, we aim to help solve some of the most pressing global medical problems, driven by curiosity and, above all, by the well-being of our patients. By bringing together the various experts researching these “good viruses” in Slovenia and abroad, we aim to build an efficient research network and library of bacteriophages where they can be accessed by other institutions, and become a leading institution for research on bacteriophages in orthopaedics. ■

+2.200	+500	+1.500	+800	+100
surgical procedures				
Primary and revision joint replacements	Spine surgery	Arthroscopic surgery	Foot and ankle surgery	Surgical treatment of bone infections
12 orthopedic surgeons	5 orthopedic surgeons	6 orthopedic surgeons	2 orthopedic surgeons	5 orthopedic surgeons

The Hospital employs 450 people, 45 of whom are specialist medical doctors. The Hospital performs over 5000 surgical procedures per year.

Valdoltra Orthopaedic Hospital
Jadranska cesta 31 | 6280 Ankaran
Slovenia

+386 5 6696 100
valdoltra@ob-valdoltra.si
www.ob-valdoltra.si

ORTHOPEDIC HOSPITAL VALDOLTRA