Is a cancer pill a matter of time?

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A cancer pill, preferably without severe side effects, is something we'd all welcome. Is it a matter of time before such a pill is a reality? We put this question to three Leiden researchers and asked how they themselves are contributing to new cancer treatments.

To get straight to the point: None of the researchers thinks there will ever be one pill that works for all forms of cancer. But there is good news too: all three are hopeful about current treatments being improved and new therapies being developed. For example, work is being done on very targeted therapies and reducing the side effects of drugs, and artificial intelligence is making drug development faster and cheaper.

Collective name

According to Sjaak Neefjes, there will never be one single cancer pill. He is Professor of Chemical Immunology at Leiden University and the Leiden University Medical Center (LUMC) and Head of the Department of Cell and Chemical Biology (LUMC). "Cancer is a collective name for very many different types of disease. Just like there isn't one antibiotic for all infectious diseases, there won't be one cancer pill."

What Neefjes can say for sure is that treatments are getting better all the time. "I can see how cancer is increasingly becoming a chronic disease. That already applies to certain forms of blood, testicular and breast cancer. A great deal of research is being done and we'll see how treatments gradually improve."

Less-severe side effects

Together with researchers from the LUMC and the Leiden Institute of Chemistry, Neefjes is also working to improve therapy. They have found a way to reduce the side effects of the widely used anticancer drug doxorubicin. Neefjes: "Doctors sometimes call it toxorubicin because it's so toxic. Patients can only have this drug a few times if any because of the side effects. The biggest problem is heart failure."

The researchers have managed to produce a less toxic version of the drug

in the lab. "We have already tested it on mice and in cell cultures," Neefjes explains. "To continue testing it, we need buckets of money." But investors aren't interested in the drug because it can't be patented. To get the drug to patients nonetheless, Neefjes is using the Spinoza grant that he was awarded in 2020. "Without this grant, it would have been years before we could continue."

Targeted therapies

Jan Verschuuren, a neurologist and immunologist at the LUMC, explains that there already are cancer pills, but that they don't treat different types of cancer. "It would be great, but making a one-size-fits-all pill is a huge challenge. What I am seeing is more and more targeted therapies."

That is what Verschuuren himself is working on together with the LUMC departments of Neurology, Pathology and Lung Disease. For the new treatment, they make use of a fascinating fact. In half of the patients with the rare Lambert-Eaton myasthenic syndrome (LEMS), this muscle disease is caused by a small cell lung carcinoma. "These patients make their own antibodies against the cancer cells. LEMS is actually a side effect of the immune system's response to the cancer cells."

Higher survival rate

The survival rate for patients with small cell lung carcinoma and LEMS is much higher than for patients whose immune system doesn't produce antibodies. In 20% of LEMS patients, the tumor disappears after chemotherapy and does not return, whereas most people with this form of lung cancer who don't have the muscle disease die within a year."

Verschuuren and the other researchers now want to isolate the antibodies from the LEMS patients and reproduce them in the lab to make a drug.

"We want to develop a more efficient therapy that may give just as good a prognosis as for the 20% of people who have discovered the trick themselves. We do expect to give patients a temporary muscle disease, but expect the muscles to recover after the treatment." Verschuuren and his colleagues don't have the luxury of a Spinoza grant for their research, so hope to soon raise half a million euros in donations so they can start their research.

Artificial intelligence

Gerard van Westen doesn't think there will ever be one cancer pill, but thinks instead that there will be increasingly better cancer treatment methods with fewer side effects. He himself doesn't work in a lab or at patients' bedsides but sits at his computer developing new drugs with the aid of artificial intelligence.

Thanks to computer models he can retrieve information from a large quantity of data. In one of his studies, Van Westen is focusing on G protein-coupled receptors. A large proportion of the drugs work via these proteins. They are found in the cell membrane, the barrier that separates the cell from the outside world, and are therefore easy to influence. Van Westen: "We use computer science and machine learning to search patient data for mutations in these proteins that are linked to cancer. We then recreate these in the lab to study whether they could play a role in cancer treatments."

They also investigate whether these mutations can be used to make drugs more selective so that they work on cancer cells but not on healthy ones. "And we are using machine learning to suggest new candidate drugs that have fewer side effects. This is a bit like making deep fakes, where new films are made by combining several films."

Virtual human

Ultimately Van Westen, his team and various partners want to create a complete picture of all the tools that they are developing by creating a virtual human. Then you can predict what candidate drugs do to the body. "Drugs are often tested on healthy men. The great advantage of a virtual human is that we can also predict how these drugs work on the elderly, children and women." Work on the virtual human has only just begun and is funded by the National Science Agenda.

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