COVID-19: Fighting viruses with viruses

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Alan Parker and his team at an event in November 2019. Credit: Cancer Research UK

Since the outbreak of COVID-19, many of our scientists have been using the techniques and approaches developed over decades of cancer research to understand and defeat the virus.

While beating cancer remains our priority, we will not be able to fully focus on our mission until COVID-19 is beaten. We're catching up with some of our researchers who are turning their expertise, experience and equipment over to COVID-19.

One lab thinks that the key is to fight the virus with another virus.

The main job of our immune system is to protect the body from potential threats—including viruses and cancer. In response to this, cancer cells have evolved multiple strategies to evade the immune system—allowing them to grow into larger and larger tumors.

At Cardiff University, Dr. Alan Parker's team looks at how we can pit one threat against another and use viruses to destroy cancer cells.

Building a Trojan Horse

The idea of giving a virus to someone with cancer may sound strange. But Parker's team believe that, with a bit of fine-tuning, viruses can be trained to focus their destructive power on cancer cells.

The lab is particularly interested in a family of family of over 50 viruses, called adenoviruses. In most people, adenoviruses cause relatively mild conditions, such as an upset stomach or a cold (depending on the type of virus).

"We're interested in how—at a molecular level—these viruses infect healthy cells and cause disease" says Parker. "By understanding how they do that, you can start to re-engineer the virus so it can hunt and destroy cancer cells."

At its simplest, a virus is a bundle of genetic information wrapped up in an incredibly tiny shell. This protective coating is made up of proteins that allow the virus to interact with cells, infect them and then hijack the cell to create more of itself.

Through genetic engineering, Parker and his team modify the adenovirus DNA so that when the virus infects tumor cells, it makes them release antigens (proteins that the immune system uses to recognise and respond to threats) that are unique to the tumor.

This release teaches the immune system to be better able to target tumor cells and so—like a trojan horse—the cells inadvertantly cause their own destruction.

A battle of two viruses

It's a technique the lab has been perfecting for several years, but their work was brought to a temporary halt by the COVID-19 outbreak.

The COVID-19 pandemic has forced universities to partially close, and a lot of Parker's lab work had to be shut down.

Like many other scientists working at home, they wondered how they could use their skills to aid

research into the virus.

After receiving a phone call from a colleague who wanted to develop tests to determine if people infected with COVID-19 had developed neutralising antibodies, Parker had a realisation—the technique his lab uses to help the immune system recognise cancer cells could also be used to train the immune system to recognise and destroy the COVID-19 virus.

"I was saying to the group, you know what might be more useful is if we engineer the adenovirus to express coronavirus antigens and use it like a vaccine."

Instead of being limited to tumor cells, the group are modifying adenovirus to enter as many cells as possible, using them as miniature factories to pump out coronavirus antigens.

This gives the immune system a chance to learn about what it can expect so when an actual COVID-19 infection occurs, the immune system is primed to deal with it.

While many labs around the world use adenoviruses as the basis for vaccines, Parker's lab has one key advantage: freezers packed full of hundreds of adenoviruses, all subtly different.

This meant they could go back to some of the adenoviruses that they had discarded in the past as not being useful for targeting cancer and examine them in a new light.

"We know we've got adenoviruses that are good at what they do. Instead of expressing a cancer antigens to help the immune system recognise and kill cancer cells, we're just going to change the tumor antigen for a viral antigen and try and make the body recognise and eliminate coronavirus when it enters the body."

"We think—based on timelines of other things we've produced—it will take us around two months to be able to produce our first batches of research grade vaccines for evaluation."

It's an exciting timeframe, but for a lab whittled down to just 4 researchers, this is just the start of the process of developing any kind of usable vaccine.

One of the pivotal moments will be injecting mice with their modified adenoviruses and seeing if the immune system can respond in a way that indicates it's primed to fight off the COVID-19 virus. But there's one big issue—mice can't be infected by COVID-19. This means the team can't test out whether the immune responses developed in mice will actually protect against the virus. Parker knows that the next step requires even more collaboration.

"I feel my role here is to make the tools and do what we can reasonably do in the in the fastest time possible, and then hand it over to the experts," says Parker.

Coming back to cancer

Although they might seem like two separate worlds, Parker think that this work into COVID-19 will allow them to get a better understanding of their own research and how adenoviruses can be optimised as treatments for cancer.

"We will take that knowledge into the cancer setting to look at how the body can respond when you provide a tumor antigen in the same way, and how it can then mount an anti-cancer response. So it all kind of feeds together—at least in my head, it does."

Provided by Cancer Research UK