Horizon
The EU Research & Innovation Magazine

European Commission

Fighting brain tumours with the help of viruses and molecules

By harnessing unusual allies, pioneering cancer treatments could reduce the need for invasive surgery and save lives.

18 December 2023 - By TEREZA PULTAROVA

Dr Marta Alonso, a Spanish biomedical researcher, developed an interest in paediatric brain tumours during a traineeship in the US state of Texas.

Alonso had a chance encounter in 2007 at the MD Anderson Cancer Center in Houston with the family of a teenager with medulloblastoma – an untreatable brain tumour that is also the most common type in children. The meeting steered her to an area of the profession with no heart-warming success stories but the potential for important advances.

Career-determining moment

'Talking to this family and understanding the difficulties and the lack of available treatments made me decide that studying paediatric brain tumours was what I wanted to do,' said Alonso.

After returning to Spain and setting up her own laboratory in 2010, she began researching cancer treatments in an emerging area called oncolytic virotherapy. This field – counterintuitively perhaps to non-specialists – involves the use of viruses to treat cancers.

Now Alonso, a faculty member in the Medical Oncology Department of the University of Navarra in Spain, leads a research project that received EU funding to make advances in virus-based treatments for brain tumours.

Called ViroPedTher, the project began in March 2019 and is due to run through August 2024.

For decades, researchers have been trying to improve the prospects for people diagnosed with brain cancer. Most patients – 97% – die within five years of diagnosis.

For every 100 000 people in the EU, approximately 11 men and 8 women develop brain tumours each year, according to the European Cancer Information System. Over 50 000 Europeans and 250 000 people globally die annually from such cancer.

Immune-system support

There are over 100 types of brain tumours, some more aggressive than others, and survival rates are generally low.

ViroPedTher focuses on two relatively rare types: gliomas and teratoid/rhabdoid tumours.

Both develop deep in the brain and affect children as young as three years. Many of these tumours can't be surgically removed as a result of their position in the brain.

'In some cases, you can use radiotherapy and there are different mixtures of drugs,' said Alonso. 'But the survival rate is very poor and the quality of life of those who live longer is usually very poor due to the side effects of treatment.'

Her approach is to use viruses as a natural ally to help stimulate the immune response of the human body to attack and destroy cancer cells.

She develops modified viruses, designed to trigger specific genetic pathways that encourage immune cells to attack tumour cells more aggressively.

Trial with children

Scientists have long known that, in some cases, viral infections can boost the immune system and help cancer patients fight off their tumours.

But common viruses may also weaken vulnerable patients and hasten their deaths.

Alonso and her team are trying to create viruses that could deliver the benefits without the risks.

In a clinical trial, the researchers injected a modified adenovirus – one of the many viruses that cause the common cold – into the brain tumours of 12 patients as young as about three years.

The adenovirus was genetically modified to maximise the immune response to the cancer cells. The children gained on average six months of life, living almost 18 more months from a usual period without the treatment of 12 months, according to Alonso.

'We didn't record any significant adverse effects, so we think we are on a right track to find a treatment that could make a difference,' she said.

Alonso and her team are fine-tuning the virus to improve its ability to turn the immune system against the tumours. The researchers hope to conduct larger-scale clinical trials as soon as mid-2024.

Glowing brains

Viruses aren't the only potential allies in the fight against brain tumours. Light is too.

This was the focus of a separate EU-funded research project led by Dr Theodossis Theodossiou, a senior researcher at the Institute for Cancer Research of Oslo University Hospital in Norway.

Named Lumiblast, the project ran for more than six years until end-January 2023 and has raised hopes of its own breakthrough. In addition to Norway, the researchers came from Greece, Spain and the UK.

The team examined the ability of light-sensitive compounds like protoporphyrin IX – which is naturally produced in human cells – to destroy brain tumours from within and avoid the need for surgery.

The researchers focused on glioblastoma, which accounts for 35% to 40% of all cases of cancerous brain tumours.

Protoporphyrin IX accumulates preferentially in glioblastoma cells. Neurosurgeons currently use its ability to glow when illuminated by light to define the boundaries of tumours during surgery.

When exposed to light, protoporphyrin IX produces oxygen byproducts called “reactive oxygen species” that destroy cancer cells, according to Theodossiou.

These molecules could, in theory, eat the tumour from the inside – if enough light could somehow be provided.

‘The problem is that tissue is not easily penetrable by light,’ said Theodossiou. ‘The penetration is probably limited to a few millimetres.’

As a result, even with open-cranium surgery needed to allow the light to penetrate, it’s impossible to reach all parts of the cancer.

Natural chemistry

So the Lumiblast researchers took another route to the same end: they hunted for compounds capable of producing a chemical reaction that would make them glow and thereby activate protoporphyrin IX without direct exposure to external light.

The process is called chemiluminescence, which also lights up fireflies as well as manufactured objects such as glow sticks, party decorations, kites and emergency lighting.

The compounds could be injected into the patient’s blood stream or administered through a drip, according to Theodossiou.

His team tested a handful of promising compounds. Several, as a result of the chemiluminescent reactions, helped destroy cultured glioblastoma cells in the lab as well as in small tumours implanted under the skin of mice.

Research has continued since the project ended and the researchers plan as soon as 2024 to test this method on tumours in animal brains.

Theodossiou believes that initial studies with human patients could start in two to three years as long as the necessary funding is available.

‘We are very optimistic and believe that this approach could offer a cure,’ he said. ‘We will be more certain after the next phase of animal experiments.’

Research in this article was funded by the EU via the European Research Council (ERC). The views of the interviewees don’t necessarily reflect those of the European Commission. If you liked this article, please consider sharing it on social media.

Beating cancer

Europe accounts for a quarter of the world’s cancer cases while representing 10% of the global population. In the EU in 2020, 2.7 million people were diagnosed with cancer and another 1.3 million people died from the disease.

The EU Mission on Cancer aims to improve the lives of more than 3 million people by 2030 through a range of actions including treatment. As a major component of the EU's investment in cancer research and innovation, the Mission will deepen understanding of the disease, focus on prevention and earlier diagnosis and improve patients' quality of life during and after their treatment.

Together with the Mission, Europe's Beating Cancer Plan is tackling the entire disease pathway from prevention to quality of life. It will enable expertise and resources to be shared across the EU, helping researchers exchange findings and medical staff and hospitals to tap into common sources of data.

More info

- ViroPedTher
- Lumiblast
- EU health research and innovation