Virus inspires new way to deliver cancer drugs

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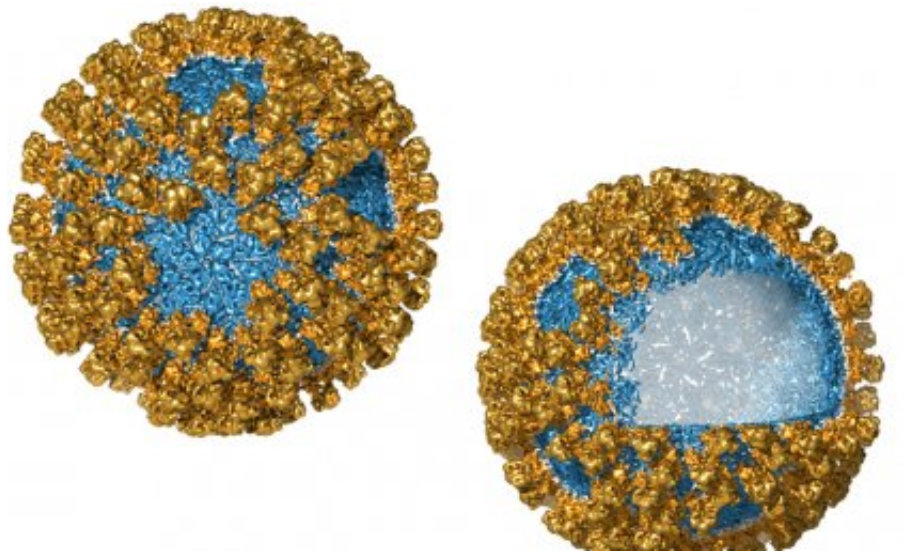

Virus-like nanoparticles are made from structural proteins. Credit: University of Queensland

Drugs disguised as viruses are providing new weapons in the battle against cancer, promising greater accuracy and fewer side effects than chemotherapy.

Researchers at The University of Queensland's Australian Institute for Bioengineering and Nanotechnology (AIBN) have designed a virus-like nanoparticle (VNP) that delivers drugs directly to the cells where they are needed.

The lead author of a paper on the topic, Dr Frank Sainsbury, said the VNP was made from the structural proteins that formed the virus's protective shell.

"Viruses have evolved to contain and protect bioactive molecules," Dr Sainsbury said. "They've also evolved smart ways to get into cells and deliver these bioactive molecules.

"The VNP is an empty shell. It looks like a virus but it's not infectious. This makes it safe to use as a targeted drug delivery system."

With infectious viral genes removed, empty shells can be loaded with small molecules or proteins resulting in a stable, well-protected therapeutic package. The outside of the shell then determines where the package will go.

The ability to send drugs directly to their target is a critical goal in the development of safe, effective therapeutics.

Currently many drugs, including anti-cancer chemotherapies, must be administered at high doses in order to have a therapeutic effect. This can lead to harsh side effects because drugs can damage healthy cells as well as intended targets.

Dr Sainsbury and his colleagues developed a VNP using the Bluetongue virus, which normally infects cows, sheep and other ruminants.

They picked the virus because of its stable shell, made of hundreds of proteins that are known to bind to a molecule found in high levels around many cancer cells.

Dr Sainsbury teamed up with Dr Michael Landsberg at UQ's School of Chemistry and Molecular Biosciences and researchers at the Institute for

Molecular Bioscience and the UK's John Innes Centre.

They were able to demonstrate that the porous VNPs could be filled with small molecules for drug delivery and it also was possible to design VNPs to contain larger molecules, such as therapeutic proteins.

Importantly, the researchers showed VNPs were able to bind to breast cancer cells, and then be absorbed.

Dr Sainsbury said the next step was to load the VNPs with anti-cancer drugs and see if they could kill cancer cells without harming healthy cells.

Although VNPs are highly complex and difficult to synthesise, Dr Sainsbury said they could be easily produced in the leaves of Nicotiana benthamiana, a wild relative of tobacco.

By providing plant cells with genetic instructions for making VNPs, the plant was able to assemble virus protein shells without any permanent change to the plant's own genetic code.

Dr Sainsbury said one day greenhouses may be able to produce large amounts of the nanoparticles within days.

"This research unlocks a myriad of potential applications in therapeutic delivery," Dr Sainsbury said.

Because the nanoparticles they have designed are highly stable, the AIBN research team is exploring other biotechnology applications.

Provided by University of Queensland