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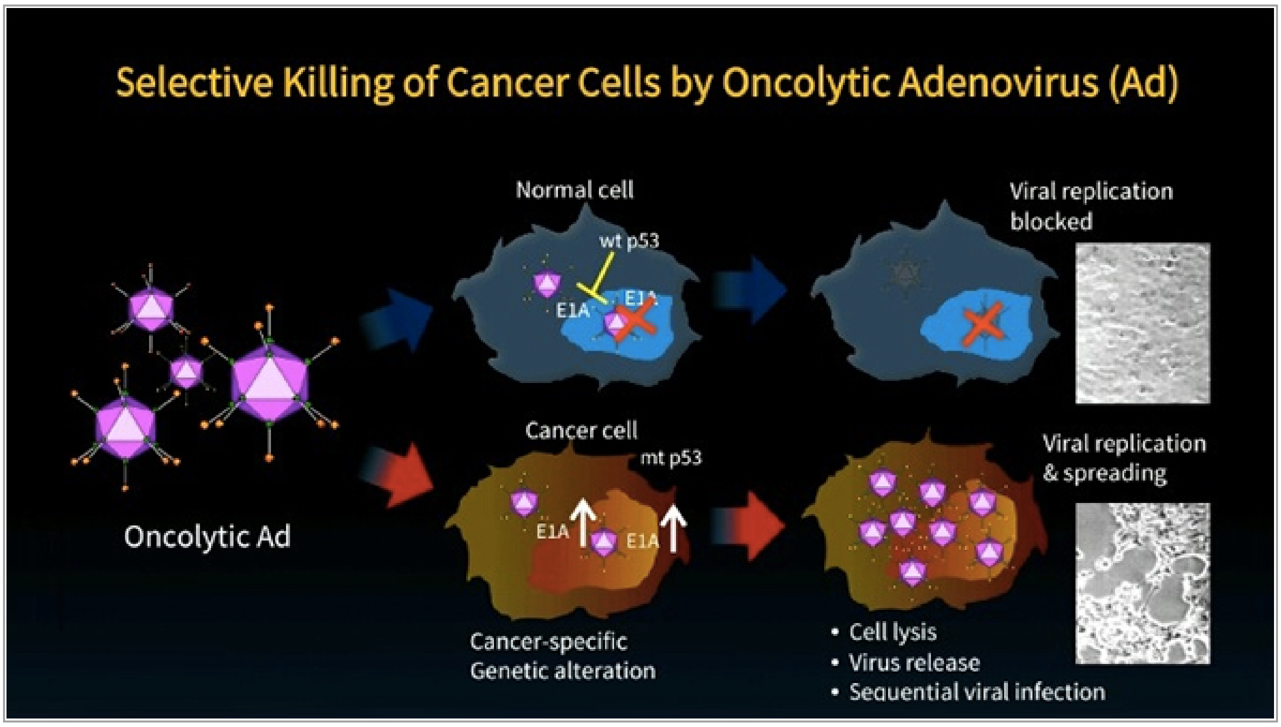
One Step Closer to Fighting Cancer

Integrating adenovirus with nanoparticles
Increasing the efficacy of cancer gene therapy

Finding the cure for cancer is one of the most well-supported and prioritised area of research in the field of biology. Professor Chae-ok Yun of the Department of Bioengineering is a researcher striving to make a significant change in cancer gene therapy. Her recently published paper, "Using a magnetic field to redirect an oncolytic adenovirus complexed with iron oxide augments gene therapy efficacy", unveils the past 4 years of her research that went into utilising adenoviruses (Ad) with nanoparticles (PCION) and iron oxide to cure cancer.

Adenovirus is a type of virus that has been developed to kill cancer cells. It is harmless to the human body, only causing slight symptoms of a cold. Adenoviruses are used frequently in treating diseases, being included in the advancement of vaccines and DNA-related cures to create necessary protein. Because of its multifarious advantages, adenovirus is utilised all over the world for clinical trials. "This virus is unique in that it has the capacity to kill specific cancer cells without affecting anything nearby," explained Yun. Called an oncolytic viral therapy in medical terminology, adenoviruses penetrate cancer cells selectively and proliferate in huge numbers to kill.



Adenoviruses penetrate cancer cells and kill them by proliferating within.

CAR (Coxsackievirus and Adenovirus Receptor) is a receptor needed for the adenoviruses to enter cells. Even though CAR can be found easily in the human body, they disappear as cancer grows. Without these receptors, adenoviruses cannot enter cancer cells. This is why iron oxide was used on top of nanoparticles. The theme of Yun's research paper was about delivering these adenoviruses directly into cancer cells with the help of a magnetic field created by nanoparticles containing iron oxide. In turn, nanomaterials become magnetically responsive due to the iron oxide contained within them. Thus, it is made possible for the viruses to go through the cells magnetically.

The clinical process involved the coating of the cancerous area and the adenoviruses with magnetised nanoparticles to assure the accurate injection of viruses into cancer cells. Responding selectively according to magnetic movements, the treatment effect increased by 30 to 40 times. The adenoviruses themselves grew by 4500 times more compared to non-coated viruses. On top of the therapy effect, safety also improved, as the shedding of cells around the tumour was prevented by the nanoparticle coating.

Replication-incompetent adenoviruses (dAd) also played a part in the clinical tests of this finding. Such viruses penetrate cancer cells but don't kill them, since they cannot proliferate. "No harm is done when dAds enter the cells, but the DNA within the viruses remain. This is how precautionary tests were done to prove the efficiency of using adenoviruses without destroying anything in the process," said Yun.

The drawback of Yun's research is that the therapeutic value was not as high as expected. There are numerous blood vessels to avoid. Systemic failure could be brought about if any type of therapeutic enters the capillaries, as it then spreads throughout the whole body.

Following the publication of her research findings, Yun has applied for a patent. She is now considering joining hands with companies willing to undertake further developments in this particular research.

To Yun, a researcher needs to be curious about science and natural phenomena. "Bioengineering is different from biology in that it looks into benefitting humans in a practical sense. The engineering departments share the notion that contributing to society is of more importance than leaving research results in papers." Although bioengineering is ambiguous and complicated because of the many variables and irregularities that exist in bioscience, those factors are what made this field especially attractive to Yun. "Further, the fact that we ourselves are the subjects of bioscience research is mesmerising. I'm thankful to have ventured into such an astonishing field of science."

Professor Yun emphasised the need for students to specialise in their own areas as well as being informed on other various disciplines.

"Nowadays, bioengineering doesn't just involve pure biology. Multi-disciplinary research is the current status quo," mentioned Yun. "Prominent research findings can't come about without the integration of numerous fields of study." Yun also emphasised the widening of one's perspective in knowledge to be essential as a student. "I always tell my students that it's important to adopt knowledge that spans a lot of disciplines. But you have to be specialised in one specific area to be truly competent in this world. There has to be depth as well as breadth." Yun believes in such 'T-shaped' aptitude; open-mindedness with substantial expertise in one field.

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