

# Analysing cancer at the single-cell level

**SINGLE-CELL SEQUENCING**, which enhances the accuracy of precision oncology therapies, is becoming accessible for clinical use in South Korea.

Ever since South Korea's early COVID-19 diagnosis kits won international acclaim, the country's burgeoning biotechnology sector has been gathering global attention. A key player in this movement is Geninus, a company spun off from the Samsung Genome Institute, which specializes in genomic analysis and precision medicine. With the latest developments, Geninus's single-cell sequencing technology is expanding its role to become a tool for diagnosing cancer.

**SINGLE-CELL ANALYSIS ALLOWS INFORMATION TO BE EXTRACTED FROM JUST CANCEROUS CELLS**

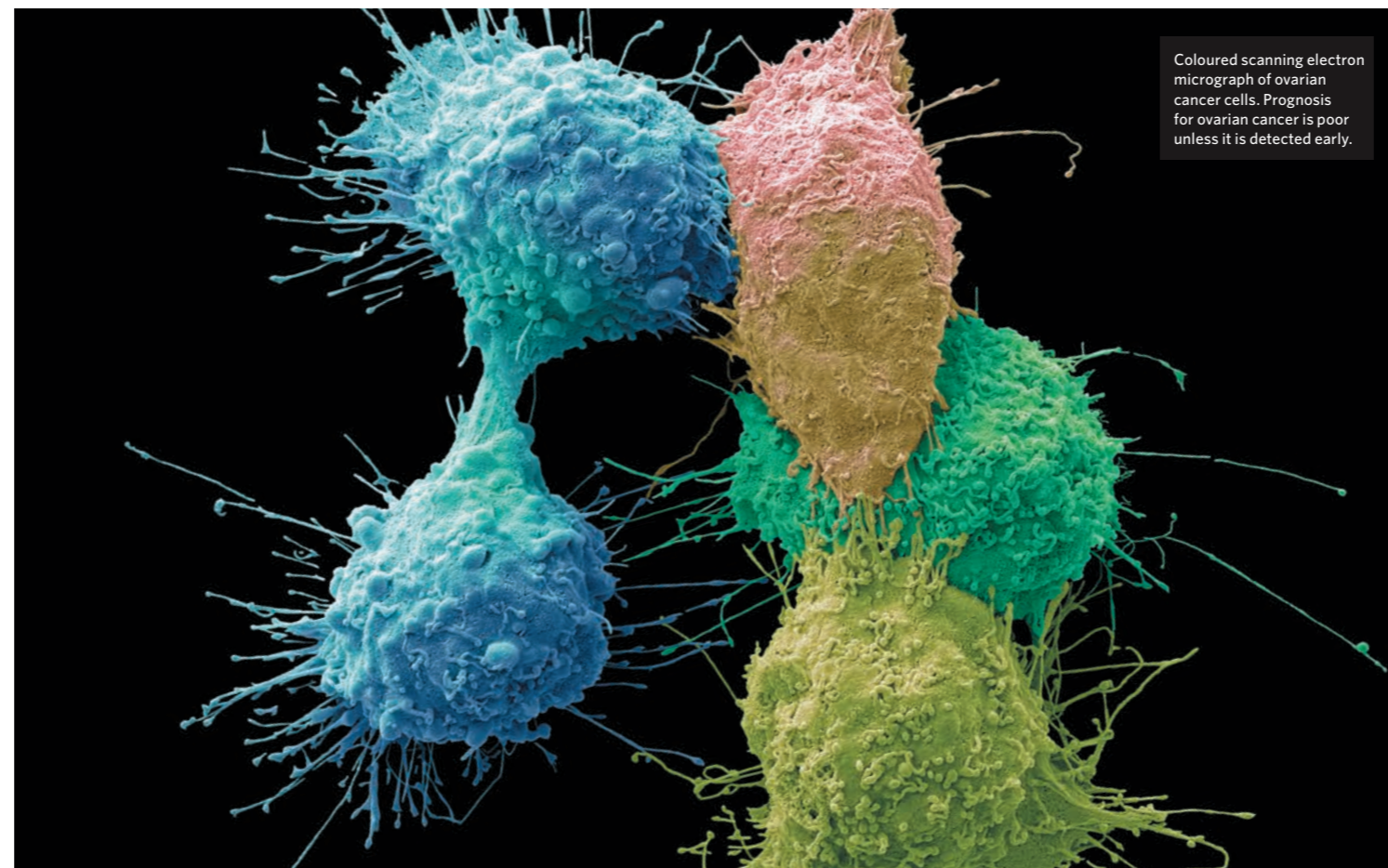
"We're living in an era when anyone can analyse their genome using next-generation sequencing," says Woong-Yang Park, who is chief executive officer at Geninus. "Single-cell sequencing is expected to follow a similar trend — everybody will be able to understand their genome based on single-cell data within the next five to ten years."

Single-cell analysis is set to transform precision cancer diagnosis and treatment. Just as organs are made up of different kinds of cells, so cancer tissues consist of various types of cells. Unlike conventional techniques that analyse tissues in bulk, single-cell analysis allows information to be extracted from just cancerous cells. "Since the basic unit of all species is single cells, researchers in various specializations have long wanted to be able to examine genomes at the single-cell level," explains Park.

Analysis of single cells really took off when the technology became available in 2013. Initiated in 2017, the Human Cell Atlas is one of the largest international initiatives to map human cell types and the genes they express. At this point, it has collected data on about 4 million single cells.

## IMPLICATIONS FOR IMMUNOTHERAPY

"We're at the stage now where we can apply this technology to developing new drugs," says Park. Celinus, Geninus's single-cell platform, provides a comprehensive



Coloured scanning electron micrograph of ovarian cancer cells. Prognosis for ovarian cancer is poor unless it is detected early.

in-house service for single-cell sequencing, including generating spatial transcriptome data that can help visualize interactions between cells. The platform helps researchers studying cancer and autoimmune diseases to analyse heterogeneity among cells to better understand cellular changes and disease status. It also helps pharmaceutical companies to determine suitable targets for new anti-cancer drugs.

"Single-cell RNA sequencing is a powerful tool for developing new immunotherapy drugs, which bolster the ability of the body's innate immune

system to fight cancer. The effectiveness of an anticancer drug can be predicted from the proportion of immune cells and the degree of related gene expression," explains Nayoung Kim, director of the Genomics Business Division at Geninus. "In this regard, Celinus has been a research product for a long time. We've recently begun to apply it to patients as the technique has been increasingly refined."

Cost reduction is critical for application in clinical settings. "Whole-genome sequencing used to cost something in the range of US\$100,000. In recent years, this has plummeted to as low as US\$600. Having shed its

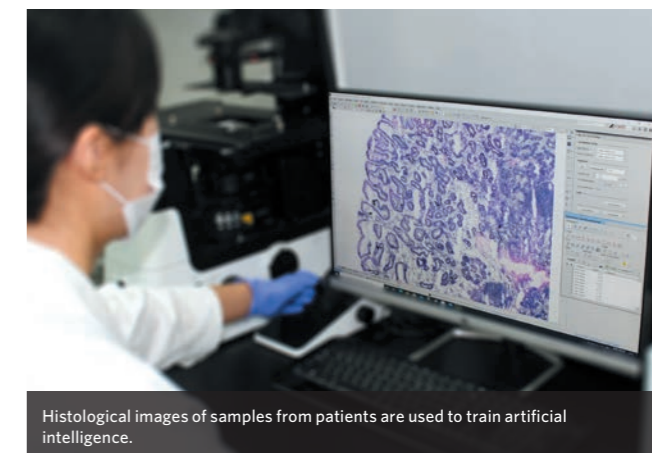
prohibitive price tag, next-generation sequencing can be used for general purposes," says Park. "Similarly, although single-cell analysis currently costs around US\$8,000 in South Korea, it will soon become more affordable and available for general use." An example is the single-cell RNA sequencing of peripheral blood mononuclear cells, which sheds light on changes in the blood caused by infections or other diseases.

## ASSISTING PATIENTS THROUGH MULTIPLE PARAMETERS

Since their time at the Samsung Genome Institute, Geninus has also provided various

services that are designed to improve the prognosis of cancer patients. One of these is CancerSCAN, which uses tissue biopsy specimens to predict disease diagnosis and the best options for treatment. Another service is LiquidSCAN, a liquid biopsy analysis that provides a non-invasive way to diagnose cancer by detecting tumour DNA circulating in the blood.

"Tissue and liquid biopsies using next-generation sequencing have been employed very routinely in hospitals across South Korea since 2017, after they started to be covered by health insurance," says Kim. "In 2020, about 20,000 next-generation



Histological images of samples from patients are used to train artificial intelligence.



Liquid biopsies based on tumour DNA circulating in the blood are much less invasive than conventional biopsies.

sequencing tests were conducted for cancer patients in South Korea. These numbers are growing every year."

When Geninus first started offering CancerSCAN in 2014, the service was able to match 10-20% patients with a specific drug. Fast-forward to 2021 and that figure has risen to 40%. Park attributes this to incorporating tumour mutational burden — a promising indicator for immunotherapy — as well as to the increase in the number of immunotherapy drugs available. "The ultimate goal is to cover 100% of patients with specific drugs based on their genomic features, so that everyone will be able to benefit

from some insight related to their genome," says Park.

"Not so far in the future, everybody will have access to their own genome data, which they can use like an avatar for characterizing the unique traits of their disease," predicts Park. "When South Korea's prowess in IT technologies is factored in, there has never been a more exciting time to be developing genome-based artificial intelligence and big-data techniques in this country." ■

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