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Singapore-made gel allows lab testing of drugs on live samples of advanced abdominal cancer

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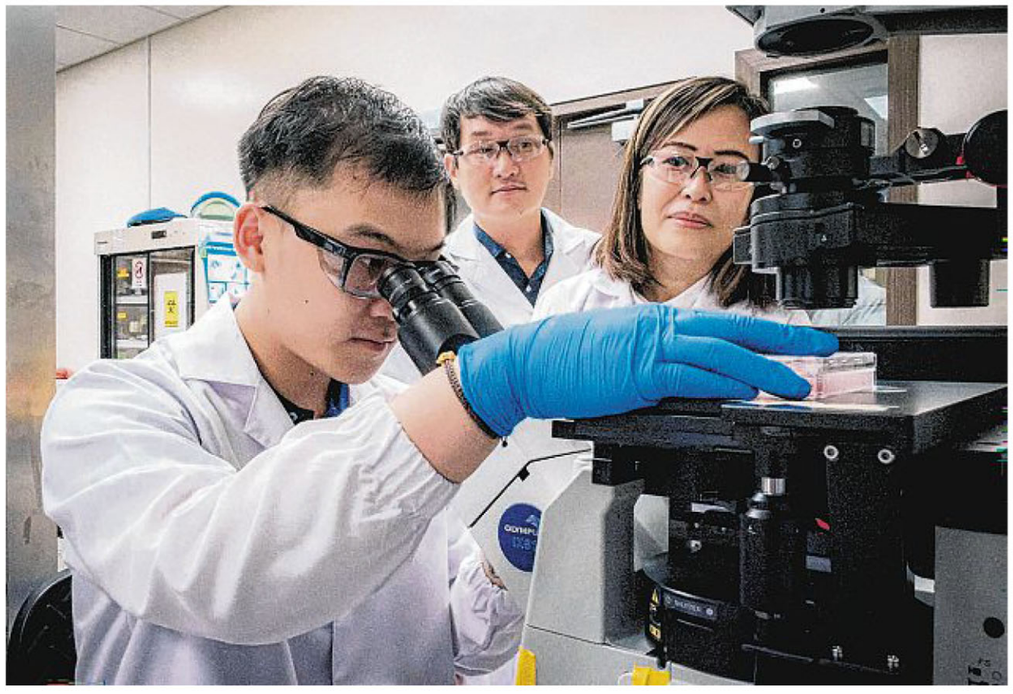

Assistant Professor Eliza Fong (at right) from NUS and Associate Professor Johnny Ong (centre) from the National Cancer Centre Singapore co-lead a study into the use of hydrogel to find individualised treatment for advanced cancer in the abdominal lining. Looking into the microscope is Mr Kenny Wu, a PhD student from NUS. PHOTO: NCCS

A hydrogel developed in Singapore to keep tumour samples alive outside the body for drug testing is now being used in research to find individualised treatment for advanced cancer in the abdominal lining.

This offers hope to some patients who face an average survival rate of just several months.

The jelly-like hydrogel is made from hyaluronic acid, a water-retentive substance found naturally in human tissues and fluids in the skin, joints and eyes.

Scientists in Singapore have found that it can keep samples of advanced cancer in the abdominal lining alive for up to 12 days, enabling them to conduct drug tests and monitor how the cancer cells react to treatment.

Without the hydrogel, cancer samples typically disintegrate within a few hours to a couple of days outside the body.

The research was conducted using samples of secondary cancer in the abdominal lining, known as secondary peritoneal metastasis. Secondary cancers are those that have spread from the original site to other parts of the body. Primary cancers refer to the original tumours.

In a 2023 study, the team had bioengineered the hydrogel to keep primary tumour samples from the head and the neck alive for 10 days to test drugs and treatments on them.

Secondary peritoneal metastasis is typically associated with advanced-stage disease. It occurs when cancer cells spread from primary sites such as the ovaries, stomach, colon, pancreas, appendix, gallbladder, breasts, uterus or lungs to the peritoneum, the protective membrane lining the abdominal cavity. The condition often poses a critical challenge in patient management in Singapore, as therapeutic options are highly limited and treatment outcome varies across patients.

"Developing clinically effective treatments remains a significantly unmet problem," said Assistant Professor Eliza Fong from the Department of Biomedical Engineering in the College of Design and Engineering at the National University of Singapore.

For instance, patients whose gastric cancer has spread to the peritoneum often face a grim prognosis and rapid disease progression.

The median survival rates range from just three to six months, and five-year survival rates are usually below 5 per cent.

"With this ground-breaking discovery, cancer that has spread to the peritoneum... may no longer be a death sentence. The findings offered hope of survival for cancer patients," said Associate Professor Johnny Ong, a senior consultant from the Department of Sarcoma, Peritoneal and Rare Tumours at the National Cancer Centre Singapore.

Cancers are made up of highly complex tissues, comprising not only the rapidly proliferating malignant cells, but also various supporting cells such as immune cells.

This means that two patients with the same type of cancer may respond differently to the same drug.

Prof Fong told The Straits Times that her team found that both the cancerous and supporting cells were preserved, allowing for the testing of chemotherapeutic drugs, targeted therapies and immunotherapies.

She said the hydrogel "is highly valuable for drug development and personalised treatments as the hydrogel-cultured tumours closely represent those in patients".

"Mechanistically, the breakthrough in this study is that we were able to show that the hydrogel effectively preserved the viability of the tumour fragments by disrupting myosin II-mediated tissue contraction," she said, referring to how the myosin II protein can cause tissues to contract and change shape.

Prof Ong noted that the study also showed how hydrogel-supported samples of peritoneal metastasis responded differently to various chemotherapeutics across patients.

He added that researchers are now leveraging the models to study how fluid build-up in the abdominal cavity affects the tumour microenvironment, or the conditions that support cancer growth.

Their findings were published in Advanced Materials, a leading journal for materials science, on May 20.

The results of the 2023 study were published in peer-reviewed journal Biomaterials on Jan 20, 2024.

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