Fighting pancreatic cancer with computers and lasers

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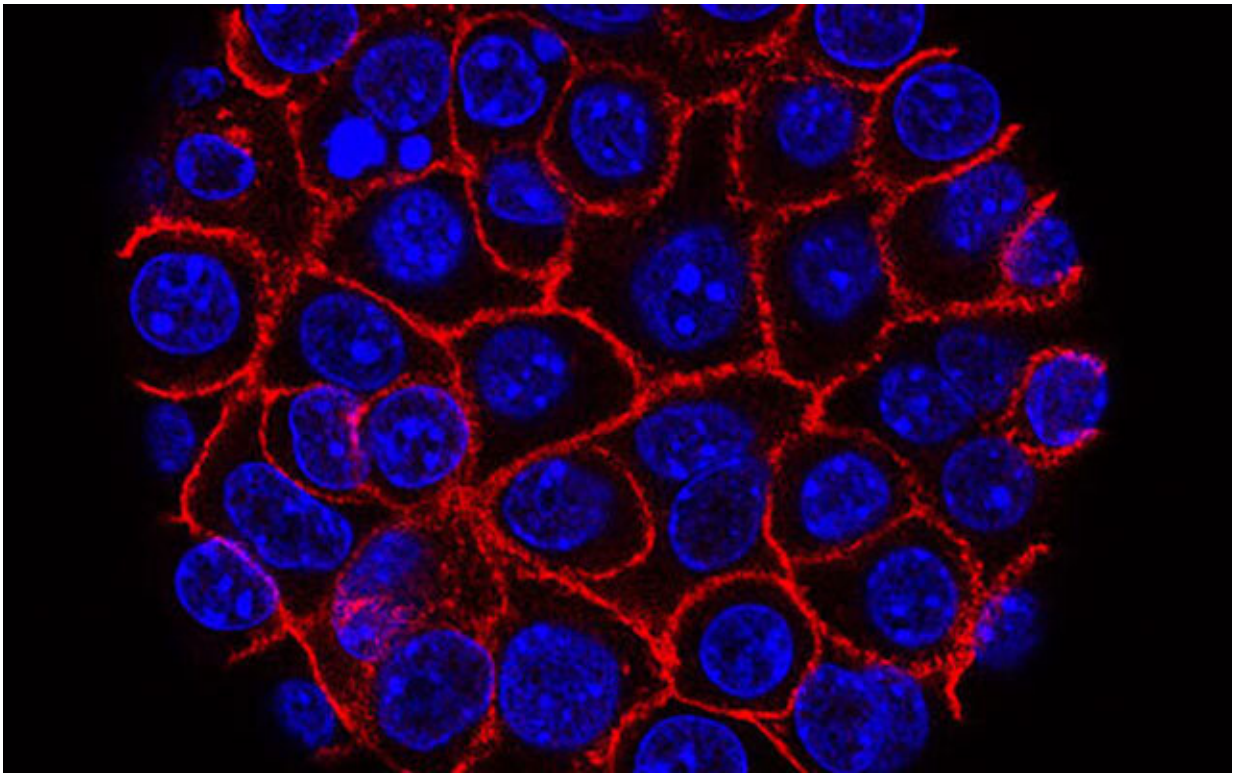

Pancreatic cancer cells (blue) growing as a sphere encased in membranes (red). Credit: National Cancer Institute

Faster detection and less invasive surgery offer hopes of advances against a leading fatal disease in Europe, pancreatic cancer.

When Dr. John Hermans meets a patient with pancreatic cancer at his hospital, he has to steel himself.

Patients with this type of tumor are often diagnosed too late to save them. On average, only 25% survive for a year and just 12% are still alive after five years.

Major killer

"One difficulty with these patients is that you very seldom have good news," said Hermans, a clinician at Radboud University Medical Center, also known as Radboud UMC, in the Netherlands.

He is part of a project that received EU funding to harness artificial intelligence (AI) to improve the prospects for people with pancreatic cancer.

Called PANCAIM, the project relies on machine learning to scrutinize patient scans and tissue samples as well as DNA from the cancer. The four-year initiative is due to wrap up in December 2024.

The pancreas is a pear-shaped gland—about 12 centimeters to 15 cm long—that lies close to the stomach and liver. It helps with digestion and with the regulation of blood-sugar levels.

In 2020, pancreatic cancer killed more than 132,000 people in Europe, according to a study. It said the risk of developing pancreatic cancer in Europe is 2.31 per 100,000 people.

While little understood, the causes may include genetic inheritance, smoking, obesity and/or age.

Hidden signs

Because the disease has already spread too far when it is detected in about 80% of patients, life-saving surgery for them is impossible.

"The only option to cure the patient is to cut out the tumor, but that's only possible with about 1 out of 5 patients," said Hermans.

People with pancreatic cancer often receive intense chemotherapy, which is physically demanding. Even with chemo, the response rates are low and it only slows the disease.

"The issue with pancreatic cancer is late diagnosis, poor outcomes and no curative chemo," Hermans said.

Under PANCAIM, computer scientists and medical doctors have teamed up to collect thousands of patient scans and train AI to recognize the early signs of pancreatic cancer.

The team says it has made progress with an AI program that automatically examines the results of CT—or computer tomography—scans.

"This seems quite capable of helping to find pancreatic cancer earlier," said Henkjan Huisman, a professor of medical imaging and AI at Radboud UMC who works closely with Hermans in PANCAIM.

High-tech hope

Patients with cancer of the pancreas often have no symptoms for a long time. And even when signs do emerge, they can be as subtle as fatigue or indigestion.

Furthermore, when a person goes for a hospital scan, the cancer is easily overlooked.

"The tumor can be visible on early CT scans but they are missed in about 40% of cases," said Hermans.

The project is gathering digital images of patient tissue, removed during surgery or by a needle biopsy.

Such slides show millions of cells that a pathologist must carefully examine for signs of cancer. This is painstaking work and small abnormalities are easily overlooked.

That's where AI can make a big difference.

"AI can do things humans can't such as spot a couple of cells among a billion or home in on tiny structures," said Huisman.

It can also easily count cell types—something exceedingly difficult for a human to do.

The project converts tissue slides from patient cancers into images and then searches for telltale footprints that could allow AI to spot the cancer earlier.

Tumor terminator

The earlier the detection of a tumor, the greater the chances it can be eliminated with lasers rather than surgery.

Lasers are the focus of Dr. Francesco Di Matteo. He is an Italian clinician who has broken medical ground by guiding a thin fiber-optic cable towards patient tumors in the pancreas to destroy them with a tiny

laser.

Now the technique is being refined by Dr. Paola Saccomandi, a biomedical engineer at the Polytechnic University of Milan in Italy, as part of another EU-funded research project.

Called LASER OPTIMAL, the project is due to wrap up in April 2024 after six years.

"The light from the laser hits the tumor cells and kills them," said Saccomandi.

Her research has used laboratory studies of animals and numerical calculations to gauge how much energy should be fired at a tumor of a given size and location.

Precision treatment

In a continuing study with Di Matteo, eight pancreatic-cancer patients so far have had their tumors scanned using magnetic resonance imaging, or MRI. Calculations were then run for individual patients.

This told the surgeon where and how much to direct at the patient's tumor. As part of a new monitoring approach, the tumor's temperature was tracked to achieve optimal temperature for destroying cancer cells.

Equally importantly, the laser should avoid killing healthy tissue as much as possible.

"The pancreas has lots of important blood vessels," said Saccomandi. "We need to be sure that the laser light does not damage the blood vessels and cause bleeding."

Her goal is to boost the laser's effectiveness as a therapy.

The idea here is to insert into the cancer tissue tiny metal rods, which then heat up when hit by a laser and kill the tumor cells close to them.

"Since the nanoparticles are delivered only to the tumor, we can improve selectivity of the treatment," said Saccomandi.

That means less unwanted heat damage to healthy cells. This isn't yet ready for patients and remains a work in progress.

The significance of what PANCAIM and LASER OPTIMAL are striving for—making it possible to detect pancreatic cancer earlier through AI and to treat such illnesses through lasering—is hard to overstate.

"That could save a lot of lives," said Hermans of PANCAIM.

More information:

- PANCAIM
- LASER OPTIMAL

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