Illuminating Cancer

Great nuclear science and sue of radioactivity

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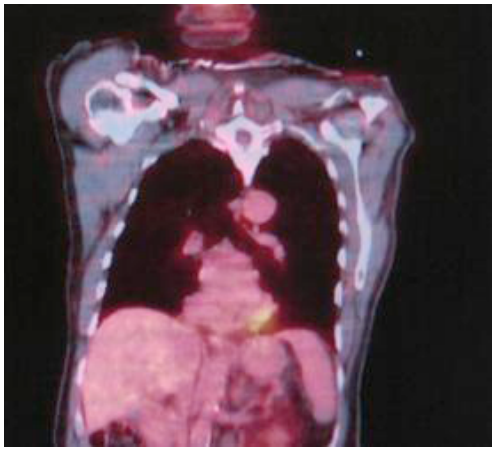

A scanner from Siemens uses information from a CT scan and a PET scan to give detailed information on the body and cancer as shown on this image at Northwest Community Hospital in Arlington Heights, Illinois, in December 2005.

A new generation of medical scanners is helping doctors quickly determine if cancer cells have spread - and to where.

The technology illuminates cancer cells as if they were tiny neon signs, helping to improve the outcome for patients as well as cut treatment costs.

"We used to see a lump in the lung and wonder, 'Is it malignant? Has it spread to the lymph nodes?' The only way to gauge was size," said Dr. Peter Cormier, a radiologist at Northwest Community Hospital in Arlington Heights, Ill. "But sometimes an enlarged lymph node has no cancer while a normal sized node does have it."

The new scanners - which are actually a combination of two existing technologies - are gaining traction across the nation. When they went on the market in 2001 the scanners generated almost $27 million in revenue. That rose to $215 million in 2002, $395 million in 2003 and is projected to reach $724 million by the end of the decade, according to figures from market researcher Frost & Sullivan.

GE Healthcare Technologies, based in Waukesha, Wis., sells about half the scanners.

The machines, known as CT/PET scanners, are a combination of a device that makes X-ray images of a patient's anatomy - computerized axial tomography, or CT - and scanners that produce images of metabolic activity, called positron emission tomography, or PET.

Both types of machines are common, but melding them into one has become a winning combination, Cormier said.

On a CT/PET image, a cancer-free node looks like other normal tissue while one with cancer cells looks bright and shiny. This is because cancer cells burn sugar about 25 times faster than normal cells. The patient ingests sugars tied to radio isotopes before the image is made, and the scanner captures the radiation given off, highlighting cells that metabolize sugar at a furious rate.

In deciding how to treat cancer, getting a precise diagnosis, or staging the disease, can be extremely important, said Dr. Reid Perlman, medical director of nuclear medicine for Evanston Northwestern Healthcare.

If the cancer is intact within a tumor, surgery may be the best choice, but if it has spread, then radiation or chemotherapy is probably a better choice, he said. "There's no point in resecting lung cancer if it's spread to the bones."

In newly diagnosed lung tumors that appear amenable to surgery, 15 percent to 20 percent aren't operable, the CT/PET images show, because the disease has spread, Perlman said.

With this diagnosis, "we spare patients large and potentially dangerous operations that cannot do them any good," he said.

Evidence that CT/PET scanning saves money and improves care has led the federal Medicare program to reimburse hospitals that use it for cancer staging, Perlman said, helping to further spread the technology.

The power of CT/PET scanning is expanding to new uses, said Perlman.

The molecule used to measure metabolism - fluorodeoxyglucose - is helpful in staging many types of cancer. It has been used to help determine whether the drug Gleevec is working to fight a stomach cancer known as gastrointestinal stromal tumors.

"Gleevec works in about three out of 10 patients who have this condition," said Michael Reitermann, president of Hoffman Estates-based Siemens Medical Solutions USA Inc. molecular imaging. "If it is going to work, you can usually see a decline in metabolic activity within 24 to 48 hours of the first treatment."

For the patients where the treatment isn't working, physicians can quickly move to another therapy, he said.

This kind of specificity makes it attractive to use scanning equipment much more widely in the future, Reitermann said during a recent meeting of the Radiological Society of North America in Chicago. Even though the equipment is expensive, it saves money by avoiding unhelpful therapies and tests, and the cost of radiology gear is coming down.

"When these systems came out, they sold for about $3 million, but that's closer to $2 million now," he said.

CT/PET imaging will expand beyond cancer staging diagnosis and treatment, predicted Joe Hogan, president of GE Healthcare Technologies. The newest machines show promise in diagnosing Alzheimer's disease and should help researchers discern what therapies may slow or reverse that disease, he said.

They may also play a role in determining the best treatment for heart patients.

"We can see what's going on with greater specificity," Hogan said. "The need for biopsies will be reduced."

To boost the technology's usefulness, the industry needs to devise other molecules besides the FDG that is so useful in tracing sugar metabolism. Researchers are working on several possibilities that would illuminate other aspects of metabolism, Hogan said.

California researchers have created a microchip that should speed this process, said Dr. Michael Phelps, director of the Institute for Molecular Medicine at the University of

California at Los Angeles. Built like electronic microchips, the new chips have tiny microfluidic pathways that enable researchers to do chemistry on a chip.

Using radioisotopes and microchip technology, researchers at hospitals, universities and labs around the country will be able to create individualized molecules for use in CT/PET scanners, Phelps said.

"Pharmaceutical companies can label a drug and watch where it goes in real patients," said Phelps. "Clinicians can use scanners to select the right patient for the right therapy."

The researchers, who published their work in the journal Science, are affiliated with UCLA, the California Institute of Technology, Stanford University, Siemens and Fluidigm.

Phelps said that commercial versions of the microchip technology could be available within two years. Once that tool gets into the hands of researchers, he said, the scope and scale of CT/PET exams should expand markedly.

"CT/PET is a big trend," he said. "This says let's put biology and anatomy together to improve diagnostic accuracy. Our goal is to put the power behind Moore's Law into health care."