McCormick News Article

Nanoscopic Changes to Pancreatic Cells Reveal Cancer


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February 17, 2009

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A team of researchers led by a Northwestern University biomedical engineer has developed a way to examine cell biopsies and detect never-before-seen signs of early-stage pancreatic cancer, according to a new paper published online by the OSA journal Optics Letters.

Though the new technique has not yet proven effective in double-blind clinical trials, it may one day help diagnose cancers of the pancreas and, potentially, other organs at their earliest and most treatable stages, before they spread.

A team from Northwestern and NorthShore University HealthSystem (NorthShore) describes the first application of the new technique, which they call "partial wave spectroscopic microscopy." This technique allows them to examine cell samples taken from people who have undergone screening for pancreatic cancer to detect signs of the disease.

Pancreatic cancer is typically diagnosed by hospital pathologists who look for telltale changes to the morphology of pancreatic cells when they examine cell biopsies under the microscope. The problem is that in the early stages of cancer, many early-stage cancer cells appear normal. By the time the cancerous cells undergo observable changes, it may be too late in the disease progression for effective treatment.

In fact, only 7 percent of people with pancreatic cancer are diagnosed in the earliest stages of the disease, when the cancer is still confined to its primary site. More than half of all people with the disease are not diagnosed until it has already metastasized.

"In the beginning, cells look normal," says Vadim Backman, a professor of biomedical engineering at Northwestern's McCormick School of Engineering and Applied Science. He developed partial wave spectroscopic microscopy with his former graduate students Yang Liu and Hariharan Subramanian and postdoctoral fellow Prabhakar Pradhan.

The new technique measures nanoscopic changes to the interior architecture of cells -- changes that may signal signs of cancer even in cells that look normal under the microscope.

To test their technique, Backman and Subramanian collaborated with Hemant K. Roy, M.D., director of gastroenterology research at NorthShore, and gastroenterologist Randall Brand, M.D., who had collected tissue samples from people undergoing biopsies to detect pancreatic cancer.

In their paper, the team reports how their new technique works. It detects fluctuations in the cells' refractive index (an optical property that measure how cells bend light passing through them). No other technique has ever measured this quantitatively, says Backman. These fluctuations are influenced by nanoscopic changes to the cells' interior architecture that often occur much earlier than the changes pathologists can detect under their microscopes. The more architectural disorder there is inside the cell, the more the refractive index fluctuates.

The researchers showed that by quantifying these fluctuations, partial wave microscopy could identify cancer cells even in cases where they had not been detected by pathologists.

Partial wave spectroscopic microscopy may be a boon to medicine, if it proves effective in clinical trials at detecting cancers early -- especially for people with pancreatic cancer, which is one of the most deadly forms of cancer. According to the National Cancer Institute, more than 37,000 men and women in the United States were diagnosed with pancreatic cancer in 2008, and statistically 95 percent of them will succumb to the disease within five years.

The Optics Letters paper is titled "Partial Wave Microscopic Spectroscopy Detects Sub-wavelength Refractive Index Fluctuations: An Application to Cancer Diagnosis."

The research was funded by a National Science Foundation SGER grant, the National Institutes of Health and the V Foundation.

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