Light-based probe 'sees' early cancers in first tests on human tissue

March 26 2007

In its first laboratory tests on human tissue, a light-based probe built by researchers at Duke University's Pratt School of Engineering almost instantly detected the earliest signs of cancer in cells that line internal organs.

If the preliminary success of the "optical biopsy" is confirmed through clinical trials, such a device could ultimately provide a particular advantage for early diagnosis, treatment and prevention of many types of cancer, according to the researchers. The vast majority of cancers start in the body's epithelial cells, which line the mucous membranes in the lungs, esophagus and gut.

"About 85 percent of all cancers start in the epithelium. It may be, for example, brain cancer that causes a patient's death, but that cancer might have originated in the colon or other site of epithelial tissue," said Adam Wax, professor of biomedical engineering. "Being able to detect pre-cancer in epithelial tissues would therefore help prevent all types of cancer by catching it early, before it has a chance to develop further or spread."

In some instances, the technique, known as "fa/LCI" (frequency-domain angle-resolved low coherence interferometry), might ultimately enable doctors and their patients to avoid removal of tissue for biopsy, Wax said. In other instances, he added, fa/LCI could help physicians pinpoint suspicious cells during a traditional biopsy procedure, making it less likely for a cancerous lesion to escape detection.

Wax and his former graduate student John Pyhtila reported in the March 2007 issue of Gastrointestinal Endoscopy that their fiber-optic device reliably differentiated between healthy and precancerous digestive tissue taken from the stomach and esophagus of three patients known to have a precancerous form of a condition called Barrett's esophagus. In less than a second, their fa/LCI-enhanced version of an endoscope, instruments used to visualize internal organs, provided the clinical information required for diagnosis.

The work was supported by the National Cancer Institute and the National Science Foundation.

"Our initial study is very promising," Wax said of the findings. "We looked at tissue removed from just a handful of patients and were able to get 100 percent sensitivity. We could detect pre-cancer in the esophagus and distinguish it from normal tissue like you would find in the stomach."

The fa/LCI device detects irregularities in the nucleus, or central component, of cells, through changes in the way laser light scatters. "The size and shape of cell nuclei are powerful indicators of this precancerous condition called dysplasia, which literally means 'bad growth'," Wax said. "Typically, nuclei are a fairly consistent size. However, when you go down the road toward cancer, you get irregular and enlarged cell nuclei.

"Our device lets us measure those changes with much better accuracy than any imaging technique," Wax said.

His team plans to begin a small clinical trial of the advanced endoscope in collaboration with researchers at Duke University Medical Center. The team also is conducting animal studies to test the feasibility of incorporating fa/LCI into instruments for examining the colon, lung and

other organs. Based on a study in hamsters, Wax and Duke postdoctoral researcher Kevin Chalut reported in the February 2007 issue of Cancer Epidemiology Biomarkers & Prevention that the technique might also be used in the identification of early lung cancer.

Wax said he and his colleagues have launched a company, called Oncoscope, to pursue the commercial development of fa/LCI devices. If all goes well, a new and improved endoscope might be ready for the clinic in three to five years, he said.

Source: Duke University