Medical Xpress

'Normal' cells far from cancer give nanosignals of trouble

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(PhysOrg.com) -- A new Northwestern University-led study of human colon, pancreatic and lung cells is the first to report that cancer cells and their non-cancerous cell neighbors, although quite different under the microscope, share very similar structural abnormalities on the nanoscale level.

The findings, obtained using an optical technique that can detect features as small as 20 nanometers, validate the "field effect," a biological phenomenon in which cells located some distance from a malignant or premalignant tumor undergo molecular and other kinds of abnormal changes.

The most striking findings were that these nanoscale alterations occurred at some distance from the tumor and, importantly, could be identified by assessing more easily accessible tissue, such as the cheek for lung cancer detection.

The partial wave spectroscopy (PWS) technique, once optimized, could be used to detect cell abnormalities early and help physicians assess who might be at risk for developing cancer. Like a pap smear of the cervix, a simple brushing of cells is all that is needed to get the specimen required for testing.

Using PWS, the researchers made another important discovery: the abnormalities found in the nanoarchitecture of the colon cells are the same abnormalities as those found in the pancreas and lung, illustrating commonality across three very different organs.

The results are published online by the journal *Cancer Research*. Authors of the paper include researchers from Northwestern and NorthShore University HealthSystem.

"Our data provide a strong argument that these nanoscale changes are general phenomena in carcinogenesis and occur early in the process," says Vadim Backman, professor of biomedical engineering at the McCormick School of Engineering and Applied Science and the paper's senior author. "These changes occur not only in cancer cells but in cells far from the tumor site and are the same in at least three different types of cancer. Given its ability to detect these changes, PWS could be used in the early screening of a variety of cancers."

Backman and his Northwestern colleagues recently developed PWS, which provides researchers with unprecedented information on the health of cells by measuring the increase in disorder -- the structural variations -- within the cell. PWS quantifies the statistical properties of cell nanoscale architecture by using the signal generated by light waves striking the complex structure of the cell.

A cell's nanoarchitecture includes the fundamental "building blocks" of the cell, which drive the molecular processes that allow a cell to function. These structures are most likely to be altered with the onset of cancer formation, says Backman, who is a member of the Robert H. Lurie Comprehensive Cancer Center of Northwestern University.

Backman's colleague and co-author, Hemant Roy, M.D., agrees. "While very preliminary, if validated, this approach may be of great clinical and biological value," says Roy, director of gastroenterology research at NorthShore. "Indeed, the ability to determine cancer risk by interrogating readily accessible tissue may provide an important step forward in cancer screening."

"Partial wave spectroscopy is a paradigm shift from conventional diagnostic techniques, which involve interrogating the actual tumor region," adds the paper's first author, Hariharan Subramanian, a postdoctoral fellow in Backman's research group.

PWS can look inside the cell and see those critical building blocks, which include proteins, nucleosomes and intracellular membranes, and detect changes to this nanoarchitecture. Conventional microscopy cannot do this, and other techniques that can (to some degree) are expensive and complex. PWS is simple, inexpensive and minimally invasive.

In the studies, cells were collected by brushing the rectum (for the colon), the duodenum (for the pancreas) and the cheek (for the lungs). The PWS technique was able to distinguish between the patients with cancer and those without. The cancer cells showed an increase in structural disorder on the nanoscale.

For each organ, the researchers next studied non-cancerous cells that neighbored tumors. When viewed using microscopy, all three cell types looked normal. PWS, however, detected a level of disorder in the cell architecture that was much closer to that of cancer cells than it was to normal cells.

The paper is titled "Nanoscale Cellular Changes in Field Carcinogenesis Detected by Partial Wave Spectroscopy."

Source: Northwestern University (news : web)