New, Molecular Approach to Early Cancer Detection

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Scientists have pioneered a new approach to detecting cancer cells, one that could eventually allow doctors to discover many malignancies earlier than currently possible.

The scientists at the University of Florida have successfully tested the technique to find leukemia cells and believe that it opens the door to the first systematic approach to diagnosing cancer at the molecular level. Not only that, but what they describe as a potentially new cancer probe may one day offer a better method of targeting individual cancer cells with drug therapies, reducing side effects from chemotherapy treatments that today affect both healthy and sickly cells.

“We can use this probe to recognize cancer cells,” potentially discovering cancer earlier than often occurs today, said Dihua Shangguan, a UF postdoctoral associate in chemistry and the first author on a paper about the approach that appears today in the online edition of the Proceedings of the National Academy of Sciences.

Contrary to popular perception, pathologists today diagnose the vast majority of cancers based on the shape or other characteristics of tumor tissue or diseased cells, said Ying Li, one of nine UF faculty members and graduate student co-authors of the paper. That’s a problem because it often means that cancers may already be advanced when detected.

“Normally, definitive diagnosis of cancer requires a visual examination of the tumor, which is an invasive and time-consuming process,”

explained Weihong Tan, a UF professor of chemistry and lead author of the paper. “Most importantly, this process is not suitable for early detection, when the cancer is at its most treatable.”

Clinicians can sometimes use antibodies, proteins that recognize and fight bodily intruders, to identify different types of cancer. That’s the case, for example, with the prostate-specific antigen test for prostate cancer. Antibodies are preferable to diagnosis by appearance because they are consistent and accurate, but they are only available for a selected few cancers, Li said.

Tan, a member of the UF Shands Cancer Center and the UF Genetics Institute, said that scientists know that cancer tissue has a unique molecular fingerprint that can distinguish it from healthy tissue. But attempts to target cells via these fingerprints have largely proved futile because there are few molecular tools to recognize the fingerprints. The UF team sought to create these tools in the form of aptamers, or short strands of chemically synthesized DNA. These aptamers exploit the differences on the surface of cells to discern cancerous ones. Key to the approach is it does not require prior knowledge of cancer indicators, Tan said.

“Using the cell-based aptamer selection strategy, we can generate aptamers which can specifically recognize any kind of cells without prior knowledge of molecular changes associated with the disease,” he said.

In experiments, the researchers showed they could successfully design sets of aptamers that would recognize leukemia cells that had been mixed in with normal bone marrow cells. The aptamers also successfully distinguished leukemia T-cells from lymphoma B-cells. Both results indicate that the aptamer method could be used to identify many different types of cancer, researchers said.

Clinicians using such molecular probes should be able to “find cancer in a much earlier stage when the tumors are much smaller,” enabling doctors to begin treatment earlier, Li said.

Richard Zare, a professor and chairman of the Stanford University department of chemistry, said he is “hugely impressed” by the findings reported in the PNAS paper.

“It represents a most clever, new approach to using the differences at the molecular level between any two types of cells for the identification of molecular signatures on the surface of targeted cells,” he said. “I can easily imagine that it will have a most significant impact on developing therapies for disease states.””

The researchers are now testing the approach on lung cancer cells, liver cancer cells and cells infected by viruses, Tang said. The paper’s other authors are Zehui Charles Cao, William Chen, Prabodhika Mallikaratchy, Kwame Sefah and Chaoyong James Yang. The work has been funded with about $1.5 million in grants from the National Institutes of Health and the National Science Foundation and about $450,000 from the office of the UF Vice President for Research.

Source: University of Florida