Paper-based technology advances earlier cancer detection
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Washington State University researchers have developed a technology that is more than 30 times more sensitive than current lab-based tests in finding early stage cancer biomarkers in blood.

The technology uses an electric field to concentrate and separate cancer biomarkers onto a paper strip. It could someday become a kind of liquid biopsy and could lead to earlier detection of and faster treatments for cancer, a disease that causes more than 9.6 million deaths a year around the world.

Led by Wenji Dong, associate professor in the Gene and Linda Voiland School of Chemical Engineering and Bioengineering, and graduate student Shuang Guo, the researchers were able to detect miniscule levels of the cancer markers in tiny extracellular bubbles called exosomes in as little as 10 minutes. Reporting on their work in the journal, *Biosensors and Bioelectronics*, the researchers call the work a "significant step" in developing rapid testing and early cancer detection.

Researchers have long sought ways to detect cancer earlier to save more lives. While lab tests to detect tumor biomarkers in blood have been developed, they often can't find early-stage cancer because the cancer markers are at levels too low to detect. Instead, people most often find out they have cancer through invasive biopsies once tumors are established.

In recent years, researchers have discovered that one of the ways cancer cells spread and communicate with other parts of the body is by way of tiny exosome vesicles in blood or other fluids. Ranging in size from 40 to 120 nanometers, or about 1000 times smaller in width than a strand of hair, the exosomes are thought to shuttle molecules from parent cancer cells through the body, entering and then re-programming friendly cells to become cancerous. Cancer cells also secrete more exosome bubbles than regular cells.

"Exosomes provide a unique opportunity as a cancer marker," Dong said.

However, finding the cancer-filled exosomes in blood testing is challenging. They look the same as normal cell exosomes and other extracellular bubbles, and they are at very low levels in the blood in early cancer.

The WSU team for the first time applied a technology that uses an electric field to rapidly isolate, enrich and detect the exosomes taken from a prostate cancer cell line.

The technology was able to concentrate and then separate the cancer-cell exosomes from those from normal cells by way of immune-binding. That is, the researchers captured the target exosomes by using an antibody that is specific to a protein marker on the exosome surface. The researchers were also able to separate out and analyze cancer protein
markers within the exosomes.

The technology was 33 times more sensitive than conventional methods that are used in research labs to detect and analyze exosomes.

"This has the potential to become a technique capable of concentrating samples by orders of magnitude in minutes," Dong said.

The researchers demonstrated their technology successfully with a test serum. They are now working to improve it using a greater amount of human blood which, with a confusing mix of hormones, lipids, and other elements floating around, can create a challenging environment for successful testing. The researchers are also working to adjust the power requirements of the technology, so that it can be used portably and more easily in a medical setting.


Provided by Washington State University