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Drugstore Cancer Tests

By Kevin Bullis October 31, 2005

Biomedical researchers have been discovering more and more proteins that reveal the presence of a cancer before its symptoms appear -- and while its treatment success rate is still high. Yet turning these findings into quick, accurate, and inexpensive diagnostic tests has proven difficult.

Recent advances in nanotech devices, however, point to new ways for developing inexpensive and effective cancer-screening devices.

One of the most promising of these new detectors is being built by Charles Lieber, a chemist at Harvard University. In an article this month in *Nature Biotechnology,* he announced a highly-sensitive detector that can simultaneously find multiple cancer markers.

According to Lieber, the device, which uses nanowires to detect telltale cancer proteins, could lead to inexpensive and highly-accurate tests -- people could even buy them in a local drugstore and perform the testing themselves. "We can take a very small amount of blood and with a very simple filtration step get an answer within five minutes," Lieber says, adding that the device has "a sensitivity a thousand times better" than in a lab.

Lieber's prototype builds on what University of California, Berkeley chemistry professor Paul Alivisatos has called "a breakthrough series of experiments." To detect specific cancer markers, Lieber attached a monoclonal antibody specific for a certain type of protein to nanowires each about as narrow as a virus. Some earlier experiments showed that changes in the conductivity of nanowires occurs when proteins bind to an antibody. The more proteins that bind, the more the conductivity changes, revealing the concentration of the protein.

In his latest device, Lieber combined multiple nanowire detectors, each primed to be sensitive to a different cancer marker. The resulting ability to detect more than one marker is the key because cancers vary.

"The bottom line is no single marker, as a general rule, has had the sensitivity to be able to be used as a definitive marker," says David Sidransky, a cancer specialist at Johns Hopkins Medical Institutions.

The problem is that levels of a single telltale protein can differ from case to case, making an assay based on one protein inherently unreliable. Sidransky says that Lieber's method of measuring multiple biomarkers simultaneously has the potential to "diagnose the vast majority of people very accurately."

In fact, according to Lieber, the "biggest advantage" of the nanowire detectors is that they could detect "10 or 100 things in parallel" without adding cost to the test.

Another benefit of the nanowire system is its flexibility. As new cancer markers are found, Lieber says, they could easily be incorporated into the device: "We could immediately take this new species and add that to our existing sensor."

In talks with Lieber, oncologists have also suggested another application. Because the device gives results in real time, it could be used to monitor the effectiveness of cancer treatments. Right now, Lieber explains, the amount of drug a patient depends on

his or her weight. Yet each person responds differently to different treatments. With such a nano-device, though, one could "fine-tune the dosage to make treatment much more effective."

Lieber and his research group have already tested the ability of the device to detect cancer markers in human blood -- a challenging task, since the target protein has a concentration around 100 billion times lower than the background proteins in serum. And they have also addressed some engineering issues with maintaining reliability.

How soon might a cancer-detecting nano-device will be available? To a large extent, it depends on developing the technology for mass production, according to Lieber, rather than with overcoming basic science obstacles. "If it's sufficiently cheap, then people can get these tests on a periodic basis and see if they're developing cancer. It could be ultimately like a CVS [pharmacy] test or a pregnancy test."

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