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NOVELTIES

Beyond the Biopsy: A Tiny Monitor for Cancer

By ANNE EISENBERG

DOCTORS doing a needle [biopsy](#) to analyze tissue for [cancer](#) may one day add a second step to the procedure: depositing a tiny device at the site to report on growth of a [tumor](#) — and even the effects of [chemotherapy](#).

Researchers at the [Massachusetts Institute of Technology](#) have created prototypes for cancer monitors the size of a grain of rice, small enough to fit easily into the bore of a biopsy needle. Tiny coated particles inside the devices can bind with molecules linked to cancer at the site, creating minuscule clumps that can be detected by a non-invasive scan like an [M.R.I.](#), said Michael J. Cima, a professor of materials science and engineering at [M.I.T.](#) and leader of the team that created the devices.

Dr. Cima tested the tiny monitors in mice. “The devices were highly sensitive,” he said. “We were able to show that in mice that had the cancer, we could detect it with the change in the M.R.I.”

The limits of existing biopsies spurred the idea for the monitors, he said.

“The biopsy is the gold standard for diagnosis,” he said. “But the downside is that you only get a measurement at the time you take the tissue.”

By contrast, the monitors can offer continuous information. “For example,” he said, “instead of trying a chemotherapy and waiting a while, you could see early indications of whether the therapy was going to work.”

Dr. Cima’s monitors could have many applications, said W. Mark Saltzman, chairman of the [department of biomedical engineering at Yale](#), where he does research on nanoparticles and drug delivery.

“The idea of being able to monitor cancer in situ is very appealing,” he said of Dr. Cima’s devices. “This work clearly demonstrates that he can do this, at least in some contexts.”

In the future, the devices may hold possibilities not only for sensing trouble, but also for remedying it, Dr. Saltzman said.

“What if you could link these devices that can detect a change in the tumor to some other device?”

he asked. That second device might then release the appropriate drug for treatment.

Dr. Cima's monitor is a small plastic container with a reservoir to sequester the magnetic nanoparticles so they can't get out. "We seal the particles in the device," he said. The particles are of the same material as those currently given to patients intravenously to improve contrast in M.R.I.'s. On the top is a membrane through which fluids diffuse into the chamber and make contact with the particles.

The magnetic nanoparticle technology used in the device was developed by Ralph Weissleder, a professor at Harvard Medical School and director of [the Center for Systems Biology](#) at [Massachusetts General Hospital](#) in Boston; he has collaborated with Dr. Cima on many projects.

They are two of the co-founders of [T2 Biosystems](#), a business in Cambridge, Mass., that is commercializing the core nanoparticle technology. The particles can detect substances, called biomarkers, that are shed by tumor cells as they develop or respond to therapy, Dr. Weissleder said.

"My laboratory focuses primarily on detecting these markers on the outside" of the body by, for example, analyzing a drop of blood, he said. Dr. Cima's focus, by contrast, "is on detecting them inside the body, through his implantable devices."

Dr. Weissleder says the technologies could help doctors when patients ask whether a tumor will respond to a particular therapy.

"Hopefully biomarkers will deliver answers and make cancer treatments a little more rational than they are today," he said.

IN the future, Dr. Cima's device may not have to be read by a large, doughnut-shaped M.R.I. machine. The group is working on another version of the implantable device, made with a metal coil that acts as a kind of antenna. This version can be read by a hand-held magnetic resonance detector.

Dr. Cima is planning a variety of devices, each set up to monitor a different metabolic activity of tissue near a tumor.

"Things as simple as pH and dissolved oxygen are known to be very good indicators of responses to therapy," he said. "If the therapy is having an impact on the survival of that tumor, you'll see it in the local metabolites."

But testing on human patients is years away. "The next step is to implant these devices in larger animals with [tumors](#) that look more like human tumors," he said.

He hopes that the devices will eventually lead to a stream of diagnostic information, he said, "to help physicians treat cancer as a chronic disease as opposed to an acute one."

E-mail: novelties@nytimes.com.

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