New imaging technique could speed cancer detection

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(Medical Xpress) -- A new imaging technique relies on light and sound to create detailed, color pictures of tumors deep inside the body. The technology, called photoacoustic tomography, may eventually help doctors diagnose cancer earlier than is now possible and to more precisely monitor the effects of cancer treatment — all without the radiation involved in X-rays and CT scans or the expense of MRIs.

Clinical trials are in the planning stages, but studies in animal models have given researchers a lot to get excited about. That's because the technology can easily penetrate the body's tissues to visualize tumors at depths never before possible.

"This technology is potentially a game changer, both in how we monitor cancer and in how soon we know it's there," says biomedical engineer Lihong V. Wang, PhD., who led the team of developers at Washington University in St. Louis.
For example, the technique could reveal the presence of cancer earlier by showing oxygen use by tissues. Excessive oxygen-burning, called hypermetabolism, is a hallmark of the disease. In the early stages, there isn't much else to go on, so photoacoustic tomography could alert physicians to the presence of the disease at its earliest stage, Wang says.

Wang explained the technology April 3 at the annual meeting of the American Association for Cancer Research in Chicago. Wang's presentation follows his publication of a related paper March 23 in *Science*.

Wang, who is affiliated with the Alvin J. Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine, is working with Washington University physicians to evaluate the technology for four uses: identifying the sentinel lymph nodes for breast cancer staging, which may eliminate the need for surgical lymph node biopsies; monitoring early response to chemotherapy; imaging melanomas; and imaging the gastrointestinal tract.

A major challenge for diagnosing cancer is the inability to see small tumors growing in the body. Physicians have come to accept the grayness of X-ray images and CT scans (which are based on X-rays), where structures appear as lights and shadows. But they are a poor substitute for “photographs” of our insides.

No such photographs exist because light can’t penetrate soft tissue. Tissues scatter light, which limits the ability to see anything beyond the depth of about a millimeter. But scattering doesn’t destroy the light, which can reach a depth of about 7 centimeters, or about 3 inches.

Photoacoustic imagery brings together the best of both worlds — light and sound. It converts light absorbed by soft tissues in the body into sound waves, which easily penetrate tissues. The tissue to be imaged is then irradiated by a nanosecond-pulsed laser at an optical wavelength.

Absorption of light by molecules beneath the surface creates a thermally induced pressure jump that launches sound waves, which are measured by ultrasound receivers at the body’s surface and reassembled to create what is, in effect, a photograph.

Photoacoustic images have a much higher contrast than X-ray images because there are many highly colored molecules in the body that naturally serve as contrast agents. These include hemoglobin, which changes color as it gains or loses oxygen, but also melanin, the pigment

that makes moles dark, and DNA, which in its condensed form in the cell nucleus is darker than the cell cytoplasm.

With a little help from organic dyes or genes engineered to express colorful products, photoacoustic tomography can also image tissues, such as lymph nodes, that would otherwise blend in with their surroundings.

“Every issue of every top journal publishes exciting lab discoveries, but only a tiny fraction of them are ever translated into clinical practice,” he says. “My hope is that photoacoustic tomography can help translate microscopic lab discoveries into macroscopic clinical practice.”

Provided by Washington University School of Medicine in St. Louis