Gold Nanobeacons Detect Sentinel Lymph Nodes

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(PhysOrg.com) -- Virtually every patient diagnosed with breast cancer or melanoma undergoes lymph node biopsy to determine if their cancer has begun spreading in the body. Taking this biopsy involves an invasive and uncomfortable procedure, and though necessary it detects metastases less than 95% of the time. To eliminate the need for invasive biopsy, and to improve upon the diagnostic sensitivity of biopsy, researchers have been working to develop non-invasive imaging techniques to identify tumor-bearing sentinel lymph nodes.

Now, a group of investigators at Washington University of St. Louis, led by Dipanjan Pan, Ph.D., and including Gregory Lanza, M.D., and Samuel Wickline, M.D., both members of the Siteman Center of Cancer Nanotechnology Excellence, has developed "soft" gold nanoparticles that accumulate in sentinel lymph nodes and that are visible using a technique known as photoacoustic imaging. The investigators published their results in the journal *Biomaterials*.

Photoacoustic imaging combines aspects of optical and ultrasound imaging in a sensitive imaging technique suitable for use in the human body. Photoacoustic imaging agents, including gold nanoparticles, emit sound waves when illuminated with specific frequencies of light. In the case of gold nanoparticles, the activating light energy occurs in the near infrared, a region of the optical spectrum that passes readily through biological tissues, and their photoacoustic emissions are strong enough to be detectable using standard clinical ultrasound equipment.

The key to this study was developing a gold nanoparticle imaging agent that balances the rate of accumulation in sentinel lymph nodes with the rate of elimination of particles that the lymph nodes do not trap. The solution was to wrap multiple gold nanoparticles, each 2-4 nanometers in diameter, within a soft polymer matrix, producing a 90 nanometer gold nanobeacon that accumulates rapidly in sentinel lymph nodes. When the investigators injected their nanobeacons into mice and imaged lymph nodes one hour later, they found that the photoacoustic signal was nine-fold stronger in lymph nodes than in surrounding blood vessels. While larger nanoparticles produced a stronger signal, they did not accumulate exclusively in the lymph nodes, so the contrast they produced was much smaller.

This work, which is detailed in a paper titled, "Near infrared photoacoustic detection of sentinel lymph nodes with gold nanobeacons," was supported in part by the NCI Alliance for Nanotechnology in Cancer, a comprehensive initiative designed to accelerate the application of nanotechnology to the prevention, diagnosis, and treatment of cancer. An abstract of this paper is available at the journal's Web site.

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