Nanoparticles Detect and Purge Metastases in Lymph Nodes

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Colonoscopy represents one of the great weapons against cancer. In one step, a physician can find precancerous lesions in the colon and then cut them out, an on-the-spot intervention that prevents cancer from developing. Now, researchers at the Winthrop Rockefeller Cancer Institute and the University of Arkansas for Medical Sciences have developed another fiber optic technique that can detect lymph node metastases and destroy them on the spot, an action that could prevent the further spread of breast cancer, melanoma, or gastrointestinal cancer, all of which spread through the lymphatic system.

As they report in the *Journal of Biophotonics*, Vladimir Zharov and his colleagues used polymer-coated iron oxide nanoparticles and gold-coated carbon nanotubes as the heart of an integrated system of several different analytical techniques and light-activated thermal therapy to detect and purge metastatic cells that invade sentinel lymph nodes. Both types of nanoparticles make excellent photoacoustic contrast enhancement agents, with each having its own characteristic interaction with pulses of laser light. When injected into mice, the investigators were able to quantify both types of nanoparticles as they accumulated in sentinel lymph nodes.

Dr. Zharov and his colleagues next showed that they could use photoacoustic techniques to detect both melanoma and breast cancer metastases in sentinel lymph nodes in mice. In fact, the investigators were able to map in real time the distribution of metastatic cells in the lymphatic system and count individual tumor cells in the sentinel lymph

nodes. The researchers then showed that they could use a fiber optic laser probe to irradiate nanoparticles that accumulated in the lymph nodes. This irradiation rapidly heats the nanoparticles, generating microbubbles in the surrounding media. The eventual microbubble collapse releases energy that kills the metastatic cells. The entire procedure, including detection and destruction of metastatic cells, took less than 30 seconds.

This work, which was supported in part by the National Cancer Institute, is detailed in a paper titled, "In vivo fiber-based multicolor photoacoustic detection and photothermal purging of metastasis in sentinel lymph nodes targeted by nanoparticles." Investigators from the Saratov State University and the Prokhorov General Physics Institute, both in Russia, the Indiana School of Medicine, and the University of Arkansas also participated in this study. An abstract of this paper is available at the journal's Web site.

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