Breast cancer treatment heats up

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In the March *Journal of Nuclear Medicine*, researchers demonstrate that miniscule bioprobes could be produced and used with molecularly targeted therapeutic heat to kill malignant breast cancer cells—without damaging nearby healthy tissue.

While many researchers have studied using heat in treating cancer, "the inability to deposit effective doses of heat in a tumor without applying similar heat to nearby normal tissue has prevented widespread clinical use," said Sally J. DeNardo, professor of internal medicine and radiology with the School of Medicine at the University of California Davis in Sacramento. "Our animal study, which combined the future-oriented sciences of nanotechnology and molecular imaging, shows that a method for delivering thermal ablation—removing or destroying cancer cells by using heat—is feasible," added the co-director of the university's radiodiagnosis and therapy section. "This exciting study—combining radiolabeled antibodies with nanoparticles or bioprobes—provides a new approach to direct thermal ablation specifically to tumor cells," she noted. DeNardo stressed that this heat treatment is in the preclinical, developmental stage, having been used only in lab mice; additional tests will need to be performed with cancer patients.

Such studies are important, explained DeNardo, indicating that breast cancer is the most common cancer among women (besides skin cancer). Statistics show that a woman has a 1 in 8 chance of developing breast cancer during her life. This year, about 200,000 women in the United States will be diagnosed with invasive breast cancer, and nearly 40,000 will die from the disease.

Scientists from UC Davis and Triton BioSystems in Boston, Mass., injected trillions of magnetic iron-containing bioprobes into the bloodstream of a lab mouse bearing a human cancer tumor. The magnetic iron nanoprobes—more than 10,000 of which can fit on the end of a straight pin—are concealed in polymers and sugars, making them nearly invisible to the body's immune system. Antibodies (joined with a radioactive substance) on these probes latched onto receptors that are on the surface of tumor cells. The heating of the probes can be activated and controlled by the use of a magnetic field from outside the body. By applying an alternating magnetic field to the tumor region, the magnetic spheres changed polarity thousands of times per second and created heat. This heat weakened—and destroyed—cancer cells. The bioprobes cooled off as soon as the alternating magnetic field was turned off and then passed out of the body. This process is described in detail in the JNM article, "Thermal Dosimetry Predictive for Efficacy of 111In-ChL6 Nanoparticle AMF–Induced Thermoablative Therapy for Human Breast Cancer in Mice."

"Using heat to kill cancer cells isn't a new concept. The biggest problems with using heat are how to apply it to the tumor cell alone, how to determine its effectiveness and how to predict the amount needed," said DeNardo. "By using heat—along with nanoparticles and a radiolabeled antibody—our quantitative imaging directed—and made safer—the application and development of therapy for cancer," she added. "This technique could join other cancer therapies, especially for cancers that are hard to treat now, such as breast cancer and metastatic melanoma," indicated DeNardo.

Source: Society of Nuclear Medicine