Tracking therapeutic nanoparticles that target breast tumors

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Researchers at Rice University, collaborating with investigators at the Baylor College of Medicine, have used two different types of imaging technologies to track the delivery of a therapeutic nanoparticle to breast tumors. The results of this study, which appear in the journal *Nano Letters*, not only demonstrate the ability to create and track multimodal nanoparticles in the body, but also provide valuable information about how targeting agents impact the fate of complex nanoparticles in the body.

This work was led by Naomi Halas at Rice and Amit Joshi at Baylor. Dr. Halas is co-principal investigator of one of 12 Cancer Nanotechnology Platform Partnerships funded by the National Cancer Institute Alliance for Nanotechnology in Cancer. Dr. Joshi is a member of the Texas Center for Cancer Nanomedicine, one of nine Centers of Cancer Nanotechnology Excellence funded by the National Cancer Institute Alliance for Nanotechnology in Cancer.

The investigators conducted their studies using a gold nanoshell to which they added a magnetic iron oxide nanoparticles embedded in a thin layer of silicon dioxide, followed by a layer of a fluorescent molecule known as ICG and targeting antibody, and finally a layer of polyethylene glycol (PEG) to render the entire construct biocompatible. For targeting breast tumors, the researchers used an antibody that recognizes the HER2 surface protein found on some forms of breast cancer.

After injecting this nanoparticle into mice bearing human tumors that overexpress the HER2 protein, the researchers used both near-infrared imaging and magnetic resonance imaging to follow the particles for the next 72 hours. Tumor levels of the nanoparticle peaked at about 4 hours after injection. In contrast, there was little nanoparticle accumulation in tumors when injected into mice bearing tumors that do not overexpress the HER2 protein. The results obtained when the animals were imaged using magnetic resonance imaging differed in that tumor levels did not peak until 24 hours after injection.

The researchers hypothesized that the two results differed because fluorescence imaging detects nanoparticles attached to the outer edge of the tumor while magnetic resonance imaging detects nanoparticles distributed throughout the tumor mass. The fact that it takes longer for nanoparticles to diffuse into the core of a tumor than to merely bind to its surface would explain the time discrepancy. Additional experiments confirmed that the nanoparticles remained intact throughout the experiment.

More information: This work, which was supported in part by the National Cancer Institute, is detailed in a paper titled "*Tracking of Multimodal Therapeutic Nanocomplexes Targeting Breast Cancer in Vivo*." An abstract of this paper is available at the journal's website.

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