Dual-Mode Nanoparticles Image Tumors Using MRI and PET

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Medical imaging represents one of the most used and useful procedures in the oncologist's diagnostic toolkit, even though each of the most useful techniques—magnetic resonance imaging (MRI), computerized tomography x-ray imaging (CT), and positron emission tomography (PET) scanning—has its own set of limitations.

The companies that make imaging instruments have responded by developing so-called dual-modality machines that can simultaneously perform two different types of scans. Now two reports in the scientific literature show how nanotechnology researchers have responded by creating dual-modality contrast agents for future use with these next-generation imaging devices.

Both of the new reports focus on magnetic nanoparticles, which are proven MRI contrast agents and also contain the radioisotopes needed to perform PET images. Jinwoo Cheon, Ph.D., Yonsei University in Korea, and his colleagues published their paper in the journal *Angewandte Chemie International Edition*. Dr. Cheon is a member of the Nanomaterials for Cancer Diagnostics and Therapeutics Center for Cancer Nanotechnology Excellence at Northwestern University. Xiaoyuan Chen, Ph.D., Stanford University, and his collaborators published their results in the Journal of Nuclear Medicine. Dr. Chen is a member of the Center for Cancer Nanotechnology Excellence Focused on Therapy Response, which is based at Stanford.

Dr. Cheon's group first created a magnetic nanoparticle from manganese

and iron and coated it with albumin, the most common protein in blood; this nanoparticle produces a very strong signal in an MRI. Next, the researchers added PET functionality by chemically attaching radioactive iodine to the albumin coating.

They then showed the value of combining MRI and PET contrast agents in the same nanoparticle in a simple experiment that compared the spatial resolution—how small an object they could image accurately—and the sensitivity—how little they could see—of each modality when using the same dual-modality nanoparticle. The spatial resolution in the MRI was far greater than that measured in the PET image, and PET imaging was able to detect far less material.

In additional tests, the investigators used their dual-modality nanoparticle to image sentinel lymph nodes in mice. Imaging sentinel lymph nodes is an important diagnostic procedure used to check for metastasis. The investigators found that layering the MRI and PET scans, acquired simultaneously on top of each other, enabled them to unambiguously identify two different lymph nodes.

Dr. Chen's group has developed a magnetic iron oxide nanoparticle modified with two different molecules: a small peptide that targets tumors and an organic molecule that entraps radioactive elements such as copper-64. The investigators then used this dual-modality agent to image tumors in mice. These images showed that the nanoparticle was indeed targeted to tumors and that tumors took up the nanoparticles. The researchers also showed that a combined MRI/PET scan easily pinpointed tumors in the test mice.

The work from Dr. Cheon's group, which is detailed in the paper "A Hybrid Nanoparticle Probe for Dual-Modality Positron Emission Tomography and Magnetic Resonance Imaging," was supported 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. To learn more about this initiative, go to nano.cancer.gov/ . Investigators from Kyungpook National University in Daegu, Korea, and the Korea Institute of Radiological and Medical Sciences in Seoul also participated in this study. There is no abstract available for this paper.
View paper citation at journal's Web site

The work from Dr. Chen's laboratory is detailed in the paper "PET/MRI Dual-Modality Tumor Imaging Using Arginine-Glycine-Aspartic (RGD)-Conjugated Radiolabeled Iron Oxide Nanoparticles." This work also was supported by the NCI Alliance for Nanotechnology in Cancer. Investigators from Brown University also participated in this study. An abstract of this paper is available through PubMed.

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