Nanoparticles Designed for Dual-Mode Imaging

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Nanoscale, inorganic fluorescent imaging agents such as quantum dots have become an important tool for researchers studying key biomolecules involved in cancer. At the same time, magnetic iron oxide nanoparticles are proving to be useful in detecting tumors and metastatic lesions thanks to their ability to act as powerful contrast agents for use with magnetic resonance imaging (MRI).

Now, researchers at Korea's Yonsei University, have married the best characteristics of these two types of nanoparticles to create a single nanoparticle probe that can yield clinically useful images of both tumors and the molecules involved in cancer.

Writing in the journal *Angewandte Chemie International Edition*, Jinwoo Cheon, Ph.D., and his colleagues describe the construction of their biocompatible dual-mode nanoparticle. The investigators start by synthesizing 30-nanometer-diameter silica nanoparticles impregnated with rhodamine, a bright fluorescent dye, and 9-nanometer-diameter water-soluble iron oxide nanoparticles. They then mix these two nanoparticles with a chemical linker, yielding the dual-mode nanoparticle. On average, ten magnetic iron oxide particles link to a single dye-containing silica nanoparticle, and the resulting construct is approximately 45 nanometers in diameter.

In somewhat of a surprise, the combination nanoparticle performed better in both MRI and fluorescent imaging tests than did the individual components. In MRI experiments, the combination nanoparticle

generated an MRI signal that was over three-fold more intense than did the same number of iron oxide nanoparticles. Similarly, the fluorescent signal from the dual-mode nanoparticle was almost twice as bright as that produced by dye molecules linked directly to iron oxide nanoparticles.

Next, the researchers labeled the dual-mode nanoparticles with an antibody that binds to molecules known as polysialic acids, which are found on the surface of certain nerve cell and lung tumors. These targeted nanoparticles were quickly taken up by cultured tumor cells and were readily visible using fluorescence microscopy.

This work, which was supported by the National Cancer Institute Alliance for Nanotechnology Excellence, is detailed in a paper titled, "Dual-mode nanoparticle probes for high-performance magnetic resonance and fluorescence imaging of neuroblastoma." This paper is available at the researcher's website.

A second paper, in which the researchers detail their development of a second dual-mode nanoparticle, was published in the *Journal of the American Chemical Society*. This paper, titled, "Biocompatible heterostructured nanoparticles for multimodal biological detection," is also available at the researcher's website.

Source: National Cancer Institute