Gold Nanoparticles Shine Brightly in Tumors

January 16 2008

Solid gold nanoparticles have long been used to treat rheumatoid arthritis and more recently have shown promise in treating various types of cancer. Now, thanks to work by Shuming Nie, Ph.D., and his colleagues at the Emory-Georgia Tech Nanotechnology Center for Personalized and Predictive Oncology, these same nanoparticles could serve as a powerful tumor-homing beacon for detecting microscopic tumors or even individual malignant cells. The researchers report their findings in the journal *Nature Biotechnology*.

Starting with colloidal gold—a commercially available suspension of gold nanoparticles—the investigators attached one of several positively charged organic dye molecules to the particles' surfaces. The chosen dye molecules absorb and emit light in the near-infrared region of the spectrum, a portion of the spectrum that passes unabsorbed through biological tissues.

The researchers then added a nanometer-thick layer of polyethylene glycol (PEG) to render the construct biocompatible. To their surprise, this coating also made the resulting optical probe incredibly stable under even harsh chemical conditions. More importantly, the optical properties of both the gold nanoparticles and the dye molecules remained constant even after application of the coating. These particles were also nontoxic to cells over periods as long as 6 days.

These initial experiments showed that the coated gold nanoparticles could serve as potent imaging agents for studies of cancer cells, but the real goal of this project was to develop targeted in vivo imaging agents

for detecting cancer in humans.

To prepare a targeted nanoparticle, the researchers used a version of PEG to which they could chemically link an antibody that binds to epidermal growth factor receptor (EGFR), a molecule overexpressed on many types of tumors. Antibodies and small molecules that bind to EGFR have been approved to treat non-small cell lung cancer.

The investigators injected the targeted nanoparticles into mice with EGFR-positive human head and neck carcinomas and obtained SERS spectra 5 hours later. As control experiments, the researchers injected matching mice with the untargeted nanoparticle. The unique optical spectra of the nanoparticles were easily detected in both sets of animals, but only the targeted nanoparticles accumulated in tumors. In contrast, the untargeted nanoparticles accumulated largely in the liver.

This work, which was supported by the National Cancer Institute's (NCI) Alliance for Nanotechnology in Cancer, is detailed in the paper "In vivo tumor targeting and spectroscopic detection with surface-enhanced Raman nanoparticle tags." An abstract of this paper is available through PubMed.

Source: National Cancer Institute