Self-Assembling Gold Nanoparticles Use Light to Kill Tumor Cells

May 26 2010

(PhysOrg.com) -- A variety of studies by numerous investigators are demonstrating that gold nanoparticles have real promise as anticancer agents. When irradiated with light, gold nanoparticles become hot quickly, hot enough to generate explosive microbubbles that will kill nearby cancer cells, a physical process known as the photothermal effect.

To boost this approach, researchers at the University of California, Los Angeles, have developed a method for creating supramolecular assemblies of gold nanoparticles that function as highly efficient photothermal agents of a size designed to optimize their delivery to tumors.

Hsien-Rong Tseng and his colleagues reported their work in the journal *Angewandte Chemie International Edition*. Dr. Tseng is a member of the Nanosystems Biology Cancer Center, a National Cancer Institute Center for Cancer Nanotechnology Excellence.

To create their self-assembling supramolecular gold nanoparticles, the researchers took advantage of a pair of molecules, cyclodextrin and adamantine, that bind very tightly to each other. They first took gold nanoparticles, 2 nanometers in diameter, and decorated the nanoparticles' surface with adamantane.They then added two other constructs: cyclodextrin attached to a biocompatible polymer known as polyethyleneimine, and adamantane linked to polyethylene glycol, another biocompatible polymer. When combined in various ratios, these

three constructs quickly assemble into nanoparticles with well defined sizes ranging from 40 to 118 nanometers in diameter. Once the complexes were purified, the researchers then attached a tumor targeting molecule to the surface of the resulting supramolecular complexes.

For this study, the investigators used the 118 nanometer gold complexes and showed that when irradiated with a laser beam, the temperature of the assemblies rapidly soared above 374° C, the temperature at which explosive microbubbles form. To test how efficiently these complexes could kill cancer cells, the researchers added them to brain tumor cells, irradiated them with light, and then measured how many cells had been killed within two hours. As a control, the researchers repeated the experiment with cells lacking the receptor for the targeting agent they added to the nanoparticles. Results from this experiment clearly showed that the targeted nanoparticles readily killed the targeted tumor cells but not the cells lacking the targeted receptor. Additional experiments showed that 2-nanometer gold nanoparticles were not nearly as effective as the supramolecular assemblies at killing the targeted cells.

This work, which is detailed in a paper titled, "Photothermal Effects of Supramolecularly Assembled Gold Nanoparticles for the Targeted Treatment of Cancer Cells," was supported in part 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. An abstract of this paper is available at the journal's Web site.

Provided by National Cancer Institute