Watery Nanoparticles Deliver Anticancer Therapy

March 7 2007

Ultrafine nanoparticles made of a lacy web of polymer and tiny pockets of water may prove to be an ideal vehicle for delivering light-activated drugs to tumors. Preliminary experiments, published in the journal *Angewandte Chemie International Edition*, show that cancer cells die quickly when treated with these nanoparticles and exposed to light.

Raoul Kopelman, Ph.D., and colleagues from the University of Michigan developed a versatile chemical technique for creating ultrafine nanosized hydrogels, essentially a network of polymer chains that absorb as much as 99 percent of their weight in water.

The researchers used the well-studied polymer known as polyacrylamide as the foundation for creating 2-nanometer-diameter nanoparticles that have no charge on their surfaces. This lack of charge prevents blood proteins from sticking to the surface of the nanoparticles. Combined with the fact that these nanoparticles are too small to be recognized by the immune system, the result is a nanoscale drug delivery vehicle with the ability to remain in circulation long enough to reach and permeate tumors before being excreted through the kidneys.

The investigators' first test of these new nanoscale hydrogels was to use them as a drug delivery vehicle for a water-insoluble light-activated drug known as a photosensitizer. In particular, the researchers chose a compound known as meta-tetra(hydroxyphenyl) chlorin, or mTHPC, which was recently approved by European regulators for use in treating head and neck cancer. mTHPC produces cell-killing reactive oxygen

when irradiated with red light, but not without serious side effects resulting from the method now used to deliver this drug to tumors.

When added to the chemical mixture used to create the nanoparticles, mTHPC becomes trapped within the polymer framework. Characterization experiments showed that this photosensitizer does not escape from the nanoparticles, yet is still capable of producing the same amount of reactive oxygen as if it were free in solution. When added to human brain cancer cells growing in culture and irradiated with red light, this formulation kills the cells rapidly. Empty nanoparticles had no effect on the cells. Neither did drug-loaded nanoparticles added to the cells that were kept in the dark.

This work, which was supported by the National Cancer Institute's Unconventional Innovations Program, is detailed in a paper titled, "Ultrafine hydrogel nanoparticles: synthetic approach and therapeutic application in living cells." An abstract of this paper is available through PubMed.

Source: National Cancer Institute