Remote Magnetic Field Triggers Nanoparticle Drug Release

November 8 2007

Magnetic nanoparticles heated by a remote magnetic field have the potential to release multiple anticancer drugs on demand at the site of a tumor, according to a study published in the journal *Advanced Materials*. Moreover, say the investigators who conducted this research, these same nanoparticles can do double duty as tumor imaging agents.

Two investigators from the Alliance for Nanotechnology in Cancer—Sangeeta Bhatia, Ph.D., Massachusetts Institute of Technology, and Erkki Ruoslahti, M.D., Ph.D., Burnham Institute—led this research effort, which has the ultimate goal of developing a targeted, multifunctional nanoparticle capable of providing time-tailored drug release into tumors.

To create such a platform, the investigators started with dextran-coated iron oxide nanoparticles similar to the ones now under development as magnetic resonance imaging contrast agents. When stimulated by an oscillating magnetic field, these nanoparticles absorb energy and become warm, a property that the researchers capitalized on to create triggered drug release.

To these particles the researchers added a short piece of DNA to act as a tether for one or more anticancer drugs linked to pieces of DNA complementary to the particle-bound tether. At body temperature, the complementary strands of DNA form the famous double helix, creating a stable link between drug molecule and nanoparticle.

But when the nanoparticle becomes warm as a result of an applied oscillating magnetic field, the bonds holding the two strands of DNA together become progressively weaker until the local temperature hits a critical value, at which point the double helix unwinds and the drug molecule diffuses away from the nanoparticle. The researchers also showed that when they applied the magnetic field in pulses of 5 minutes duration every 40 minutes, drug release occured in bursts, too.

Since this “melting temperature” depends on the length of the double helix, the investigators reasoned that they could use tethers of different lengths to produce one nanoparticle capable of releasing two or more drugs in sequence. Indeed, when the researchers attached two different model drug compounds to the nanoparticle using tethers of two different lengths, they were able to trigger release of the drug attached via the shorter tether and follow that with release of the second drug, attached with the longer tether, by increasing the power of the oscillating magnetic field.

This work, which was funded by the NCI’s Alliance for Nanotechnology in Cancer, is detailed in the paper “Remotely triggered release from magnetic nanoparticles.” Investigators from the University of California, San Diego, also participated in this study. This paper was published online in advance of print publication. An abstract of this paper is not yet available.

Source: National Cancer Institute