Chemists Create Cancer-Detecting Nanoparticles

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Magnetic resonance imaging (MRI) can be a doctor's best friend for detecting a tumor in the body without resorting to surgery. MRI scans use pulses of magnetic waves and gauge the return signals to identify different types of tissue in the body, distinguishing bone from muscle, fluids from solids, and so on.

Scientists have found that magnetic nanoparticles can be especially helpful in locating cancerous cell clusters during MRI scans. Like tiny guide missiles, the nanoparticles seek out tumor cells and attach themselves to them. Once the nanoparticles bind themselves to these cancer cells, the particles operate like radio transmitters, greatly aiding the MRI's detection capability.

Now, a team of researchers led by Shouheng Sun, Ph.D., of Brown University, and Xiaoyuan Chen, Ph.D., a member of the Stanford University Center for Cancer Nanotechnology Excellence Focused on Therapy Response, have created the smallest magnetic nanoparticles to date that can be employed on such seek-and-find missions. With a thinner coating, the particles also emit a stronger signal for the MRI to detect. Their work appears in the *Journal of the American Chemical Society*.

The team created iron oxide nanoparticles coated with a peptide-based targeting agent. The researchers injected the particles into mice and tested their ability to locate a brain tumor cell called U87MG. The investigators concentrated specifically on the nanoparticle's size and the thickness of the peptide coating, which ensures that the nanoparticle attaches to the tumor cell.

Size is important because the trick is to create a nanoparticle that is small enough to navigate through the bloodstream and reach the diseased area. Bigger particles tend to stack up, creating the circulatory system's version of a traffic jam. The investigators developed a nanoparticle that is about 8.4 nanometers in overall diameter—some six times smaller than the size of particles currently used in medicine.

The coating, while integral to the nanoparticles' attachment to the tumor cell, also is crucial to establishing the "signal-to-noise" ratio that a MRI uses. The thinner the coating, the stronger the emitted signal and vice versa. The research team outfitted its nanoparticles with a 2-nanometer thick peptide coating—10 times thinner than the coating available in popular MRI contrast agents such as Feridex.

Another important feature of the team's work is discovering that the RGD peptide coating binds almost seamlessly to the U87MG tumor cell. The team plans to test the particle's ability to bind with other tumor cells in additional animal experiments.

This work, which was supported in part by the NCI's Alliance for Nanotechnology in Cancer, is detailed in the paper "Ultrasmall c(RGDyK)-Coated Fe3O4 Nanoparticles and Their Specific Targeting to Integrin αvβ3-Rich Tumor Cells." An abstract of this paper is available at the journal's Web site. (pubs.acs.org/cgi-bin/abstract. … p/abs/ja802003h.html)

Source: National Cancer Institute