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Nanoworms Target Tumors

By linking strings of spherical iron oxide nanoparticles and coating the resulting construct with a biocompatible polymer, a multi-institutional research team has created “nanoworms” that can better target tumors and produce stronger magnetic resonance imaging (MRI) signals than their component nanoparticles. The nanoworms also appear to be a promising vehicle for carrying anticancer drugs into tumors. The researchers published their work in the journal *Advanced Materials*.

“Most nanoparticles are recognized by the body’s protective mechanisms, which capture and remove them from the bloodstream within a few minutes,” said Michael Sailor, Ph.D., of the University of California, San Diego and a member of the Center of Nanotechnology for Treatment, Understanding, and Monitoring of Cancer (NANO-TUMOR), one of eight Centers of Cancer Nanotechnology Excellence (CCNEs) funded by the National Cancer Institute (NCI). Sailor, along with Erkki Ruoslahti, M.D., Ph.D., of the Burnham Institute for Medical Research and a NANO-TUMOR member, and Sangeeta Bhatia, M.D., Ph.D., of the Massachusetts Institute of Technology (MIT) and a member of the MIT-Harvard CCNE, led the team of investigators that developed the nanoworms and is testing them as tumor imaging agents.

“The reason these worms work so well is due to a combination of their shape and to a polymer coating on their surfaces that allows the nanoworms to evade these natural elimination processes,” added Sailor. “As a result, our nanoworms can circulate in the body of a mouse for many hours.”

Iron oxide nanoparticles are superparamagnetic, which makes them show up very brightly in MRI scans. The magnetism of the individual iron oxide segments, typically eight per nanoworm, combine to provide a much larger signal than can be observed if the segments are separated. This translates to a better ability to see smaller tumors, hopefully enabling physicians to make their diagnosis of cancer at earlier stages of development.

In addition to the polymer coating, which is derived from the biopolymer dextran, the scientists coated their nanoworms with a tumor-specific targeting molecule, a peptide called F3. This peptide allows the nanoworms to target and home in on tumors. “Because of its elongated shape, the nanoworm can carry many F3 molecules that can simultaneously bind to the tumor surface,” said Sailor. “And this cooperative effect significantly improves the ability of the nanoworm to attach to a tumor.”

The scientists were able to verify that the nanoworms homed in on tumor sites by injecting them into the bloodstream of mice with tumors and following the aggregation of the nanoworms on

the tumors. They found that the nanoworms, unlike the spherical nanoparticles of similar size that were shuttled out of the blood by the immune system, remained in the bloodstream for hours. Although it is not clear yet why these nanoworms have such a long life in the bloodstream, the researchers note that the nanoworm's flexibly moving, one-dimensional structure may be one reason.

This work, which was supported by the NCI's Alliance for Nanotechnology in Cancer, is detailed in the paper "Magnetic Iron Oxide Nanoworms for Tumor Targeting and Imaging." There is no abstract available for this paper, but a citation is available at the journal's Web site.
View citation