Progress in using magnetic fields to target tumors

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(Phys.org)—Since the advent of cancer nanotechnology, researchers have sought to use magnetic fields to increase the concentration of drug-loaded iron oxide nanoparticles that reach a tumor. However, magnetic fields drop off quickly with distance, making it almost impossible to consider such an approach for tumors located more than a few centimeters from the skin. To solve what appears to be a fundamentally unsolvable problem, researchers at the Stanford University Center of Cancer Nanotechnology Excellence (Stanford CCNE) have taken a two-pronged approach, one that uses an external magnetic field and an implantable magnetizable mesh to create local magnetic fields strong enough to trap nanoparticles at a specific location.

Sanjiv Gambhir and Shan Wang led the research team that developed this new approach to magnetic targeting. The team reported its findings in the journal *ACS Nano*. Drs. Gambhir and Wang are the co-principal investigators of the Stanford CCNE.

To boost the strength of the magnetic field near a tumor, the investigators used a commercially available micromesh made of nickel. When implanted close to tumors growing in mice, the mesh developed strong magnetic field gradients when a permanent magnet was placed next to the animal. These gradients were sufficient to capture large numbers of biocompatible magnetic iron oxide nanoparticles that the researchers injected into the animals.

The idea driving this work is that such a mesh could be implanted near a tumor in a procedure that would be far less invasive than tumor-removing surgery. The patient could then be treated with magnetic nanoparticles carrying large doses of antitumor drug. Such a procedure could also be useful in cases where surgical tumor removal is not feasible.

In one set of experiments, the investigators dosed tumor-bearing animals with an iron oxide nanoparticle coated with a molecule known to block angiogenesis, the growth of new blood vessels that tumors require to grow and spread. While the nanoparticles alone caused tumors to shrink, when administered along with magnetic field trapping, the rate of tumor shrinkage increased dramatically. The investigators noted that effect of generating a localized magnetic field in the vicinity of the tumor was similar to that seen when they doubled the dose of anti-angiogenic nanoparticles without additional magnetization.

More information: "Fluorescent magnetic nanoparticles for magnetically enhanced cancer imaging and targeting in living subjects." *ACS Nano*. dx.doi.org/10.1021/nn301670a

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