Nanoparticles and Lasers Create Cancer-Killing Microbubbles

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One promising use of gold nanoparticles is to use them to convert laser energy into heat that can kill malignant cells. Now, in a promising twist on this approach to anticancer therapy, an international team of investigators has developed a method that uses clusters of gold nanoparticles to create vapor microbubbles that can kill targeted cells.

Reporting their work in the journal Lasers in Surgery and Medicine, Dmitri Lapotko, Ph.D., from the Luikov Heath and Mass Transfer Institute in Minsk, Belarus, and colleagues used antibody-targeted gold nanoclusters to selectively destroy leukemia cells present in human bone marrow samples. To achieve optimal targeting, the investigators used a two-stage labeling technique.

In the first stage, they used diagnosis-specific monoclonal antibodies, that is, the antibodies used by clinical laboratories to diagnose specific subsets of acute B-lymphoblast leukemia (ALL) in human patients, to label the malignant cells. This type-specific antibody serves as the target for the second monoclonal antibody, which is attached to the gold nanoparticles.

Imaging studies showed that tumor cells took in only the dual-targeted nanoparticles and that normal cells did not take up the nanoparticles. As the nanoparticles accumulate within the targeted tumor cells, they form nanoclusters that generate microbubbles when activated by laser light. One advantage that comes from allowing nanoclusters to form is that nanoclusters can create microbubbles at lower laser power than can

individual nanoparticles, thus reducing potential damage to healthy tissue.

In fact, single laser pulses were able to generate microbubbles within the targeted cells, an event that does not occur with free nanoparticles in solution. Experimental results showed up to 85 percent of targeted tumor cells were killed after a single laser pulse. Multiple pulses killed more than 99 percent of the tumor cells.

This work is detailed in a paper titled, “Selective laser nano-thermolysis of human leukemia cells with microbubbles generated around clusters of gold nanoparticles.” An investigator from Fairway Medical Technologies in Houston also participated in this study. An abstract of this paper is available through PubMed.

Source: National Cancer Institute