DNA-Coated Nanotubes Help Kill Tumors Without Harm to Surrounding Tissue

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(PhysOrg.com) -- Researchers at Wake Forest University School of Medicine have destroyed prostate cancer tumors in mice by injecting them with specially-coated, miniscule carbon tubes and then superheating the tubes with a brief zap of a laser.

The procedure, which used DNA-encased, multi-walled carbon nanotubes (MWCNTs) to treat human prostate cancer tumors in mice, left only a small burn on the skin that healed within days.

"That we could eradicate the tumor mass and not harm the tissue is truly amazing," said principal investigator William H. Gmeiner, Ph.D., a professor of cancer biology at the School of Medicine.

An advance copy of the study is now available in the online edition of *ACS Nano* and the full paper is scheduled to appear in a future print issue.

The researchers envision using the particles not only to kill tumors through heating, but also to target cancer drugs to the diseased area in patients.

"The long-term goal in the project is to be able to use the DNA-encased MWCNTs in multi-modality fashion for a variety of types of tumors," Gmeiner said.

Carbon nanotubes are sub-microscopic particles that have been the

subject of intense cancer research. The MWCNTs used in the current study consist of several nanotubes that "fit inside one another like Russian dolls," Gmeiner said. The MWCNTs are injected into a tumor and then heated with laser-generated near-infrared radiation. For this study, the tubes were injected into human prostate cancer tumors being grown in mice. The radiation causes the tubes to vibrate, creating heat. That heat kills the cancer cells near the nanotubes. If there are enough nanotubes, the amount of heat generated can kill whole tumors.

For this study, researchers used MWCNTs encased with DNA, which prevented them from bunching up in the tumor, allowing them to heat more efficiently at a lower level of radiation and leaving the surrounding tissue virtually unharmed.

With funding from the National Cancer Institute and the North Carolina Biotechnology Center, researchers grew 24 prostate cancer tumors in 12 mice. They then separated the mice into groups receiving treatment with DNA-encased MWCNTs and laser, laser only, non-DNA-encased MWCNTs only, or no treatment.

The eight tumors treated with a single injection of DNA-encased MWCNTs and zapped with a 70-second burst from a three-watt laser were gone within six days after treatment. While a minor surface burn appeared at the site of laser treatment, it healed within a few days with antibiotic ointment, Gmeiner said.

The tumors in the other treatment groups showed no distinguishable reduction.

Using the DNA-encased MWCNTs increased heat production two- to threefold - allowing researchers to use fewer nanotubes and a less powerful laser to kill tumors - an important consideration as scientists determine potential issues with the toxicity of nanotubes, since they

remain in the body after treatment, Gmeiner said.

Current thermal ablation, or heat therapy, treatments for human tumors include radiofrequency ablation, which causes regional heating between two electrodes implanted in tissue but cannot be used to selectively distinguish cancer cells from healthy cells, like researchers hope they will be able to do with MWCNTs. In addition to the DNA-encased MWCNTs used in this study, other nanomaterials, such as single-walled carbon nanotubes and gold nanoshells, are also currently undergoing experimental investigation as cancer therapies.

Before treatment with MWCNTs can be tested in humans, studies need to be done to test the toxicity and safety, looking to see if the treatment causes any changes to organs over time, as well as the pharmacology of the treatment, to see what happens to the nanotubes, which are synthetic materials, over time.

Source: Wake Forest University Baptist Medical Center (news : web)