UT SOUTHWESTERN MEDICAL CENTER NEWS

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Nanotechnology, biomolecules and light unite to 'cook' cancer cells

DALLAS – June 16, 2008 – Researchers are testing a new way to kill cancer cells selectively by attaching cancer-seeking antibodies to tiny carbon tubes that heat up when exposed to near-infrared light.

Biomedical scientists at UT Southwestern Medical Center and nanotechnology experts from UT Dallas describe their experiments in a study available online and in an upcoming print issue of *Proceedings of the National Academy of Sciences.*

Scientists are able to use biological molecules called monoclonal antibodies that bind to cancer cells. Monoclonal antibodies can work alone or can be attached to powerful anti-cancer drugs, radionuclides or toxins to deliver a deadly payload to cancer cells.

In this study, the researchers used monoclonal antibodies that targeted specific sites on lymphoma cells to coat tiny structures called carbon nanotubes. Carbon nanotubes are very small cylinders of graphite carbon that heat up when exposed to near-infrared light. This type of light, invisible to the human eye, is used in TV remote controls to switch channels and is detected by night-vision goggles. Near-infrared light can penetrate human tissue up to about 1½ inches.

In cultures of cancerous lymphoma cells, the antibody-coated nanotubes attached to the cells' surfaces. When the targeted cells were then exposed to near-infrared light, the nanotubes heated up, generating enough heat to essentially "cook" the cells and kill them. Nanotubes coated with an unrelated antibody neither bound to nor killed the tumor cells.

"Using near-infrared light for the induction of hyperthermia is particularly attractive because living tissues do not strongly absorb radiation in this range," said Dr. Ellen Vitetta, director of the Cancer Immunobiology Center at UT Southwestern and senior author of the study. "Once the carbon nanotubes have bound to the tumor cells, an external source of near-infrared light can be used to safely penetrate normal tissues and kill the tumor cells.

"Demonstrating this specific killing was the objective of this study. We have worked with targeted therapies for many years, and even when this degree of specificity can be demonstrated in a laboratory dish, there are many hurdles to translating these new therapies into clinical studies. We're just

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beginning to test this in mice, and although there is no guarantee it will work, we are optimistic."

The use of carbon nanotubes to destroy cancer cells with heat is being explored by several research groups, but the new study is the first to show that both the antibody and the carbon nanotubes retained their physical properties and their functional abilities – binding to and killing only the targeted cells. This was true even when the antibody-nanotube complex was placed in a setting designed to mimic conditions inside the human body.

Biomedical applications of nanoparticles are increasingly attracting the attention of basic and clinical scientists. There are, however, challenges to successfully developing nanomedical reagents. One is the potential that a new nanomaterial may damage healthy cells and organisms. This requires that the effects of nanomedical reagents on cells and organisms be thoroughly studied to determine whether the reagents are inherently toxic.

"There are rational approaches to detecting and minimizing the potential for nonspecific toxicity of the nanoparticles developed in our studies," said Dr. Rockford Draper, leader of the team from UT Dallas and a professor of molecular and cell biology.

Other researchers from UT Southwestern involved in the research were lead authors Pavitra Chakravarty, a graduate student in biomedical engineering, and Dr. Radu Marches, assistant professor in the Cancer Immunobiology Center. Authors from UT Dallas' Alan G. MacDiarmid NanoTech Institute were Dr. Inga Musselman, Dr. Paul Pantano and graduate student Pooja Bajaj. Two undergraduate students in UT Southwestern's Summer Undergraduate Research Fellowship program – Austin Swafford from UT Dallas and Neil Zimmerman from the Massachusetts Institute of Technology – also participated.

The research was supported by the Cancer Immunobiology Center at UT Southwestern, the Robert A. Welch Foundation, the Department of Defense and the Center for Applied Biology at UT Dallas.

Dr. Vitetta is a co-inventor on a patent describing the techniques outlined in the study.

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