Radio Waves Fire Up Nanotubes Embedded in Tumors, Destroying Liver Cancer

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Cancer cells treated with carbon nanotubes can be destroyed by noninvasive radio waves that heat up the nanotubes while sparing untreated tissue, a research team led by scientists at The University of Texas M.D. Anderson Cancer Center and Rice University has shown in preclinical experiments.

In a paper published in the journal *Cancer*, the researchers demonstrated that the technique completely destroyed liver cancer tumors in rabbits. There were no side effects noted. However, some healthy liver tissue within 2 to 5 millimeters of the tumors sustained heat damage due to nanotube leakage from the tumor.

"These are promising, even exciting, preclinical results in this liver cancer model," said lead investigator Steven Curley, M.D., of M.D. Anderson. "Our next step is to look at ways to more precisely target the nanotubes so they attach to, and are taken up by, cancer cells while avoiding normal tissue."

Curley conducted the research in collaboration with nanotechnology experts at Rice University and with Erie, Pennsylvania, entrepreneur John Kanzius of ThermMed LLC, who invented the experimental radiofrequency generator used in the experiments. Kanzius is a cancer survivor and former radio station owner whose insights into the potential of targeted radio waves inspired this line of research. At Rice, the work was begun by Nobel laureate Richard Smalley several months before his death from cancer in October 2005.

In the liver cancer experiment, a solution of single-walled carbon nanotubes was injected directly into the tumors. Four treated rabbits were then exposed to 2 minutes of radiofrequency treatment, resulting in thermal destruction of their tumors. Control group tumors that were treated only by radiofrequency exposure or only by nanotubes were undamaged. In lab experiments, two lines of liver cancer cells and one pancreatic cancer cell line were destroyed after being incubated with nanotubes and exposed to the radiofrequency field.

Curley stated that radiofrequency energy fields penetrate deeply into tissue, so it would be possible to deliver heat anywhere in the body if targeted nanotubes or other nanoparticles can be delivered to cancerous cells. Without such a target, radio waves will pass harmlessly through the body.

An invasive technique known as radiofrequency ablation is used to treat some malignant tumors, the authors note. It requires insertion of needle electrodes directly into the tumors. Incomplete tumor destruction occurs in 5 to 40 percent of cases; normal tissue is damaged, and complications arise in 10 percent of patients who suffer such damage. Radiofrequency ablation is limited to liver, kidney, breast, lung, and bone cancers.

This work is detailed in the paper “Carbon nanotube-enhanced thermal destruction of cancer cells in a noninvasive radiofrequency field.” Investigators from Rice University, ThermMed LLC, and the National Center for Scientific Research in Bordeaux, France, also participated in this study. This paper was published online in advance of print publication. An abstract of this paper is available through PubMed.

Source: National Cancer Institute