Researchers effectively treat tumors with use of nanotubes

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By injecting man-made, microscopic tubes into tumors and heating them with a quick, 30-second zap of a laser, scientists have discovered a way to effectively kill kidney tumors in nearly 80 percent of mice. Researchers say that the finding suggests a potential future cancer treatment for humans.

The study appears in the August issue of *PNAS* (Proceedings of the National Academy of Sciences). It is the result of a collaborative effort between Wake Forest University School of Medicine, the Wake Forest University Center for Nanotechnology and Molecular Materials, Rice University and Virginia Tech.

"When dealing with cancer, survival is the endpoint that you are searching for," said Suzy Torti, Ph.D., lead investigator for the study and professor of biochemistry at Wake Forest University School of Medicine. "It's great if you can get the tumor to shrink, but the gold standard is to make the tumor shrink or disappear and not come back. It appears that we've found a way to do that."

Nanotubes are long, thin, sub-microscopic tubes made of carbon. For the study, researchers used multi-walled nanotubes (MWCNTs), which contain several nanotubes nested within each other, prepared for the study by the Center for Nanotechnology and Molecular Materials. The tubes, when non-invasively exposed to laser-generated near-infrared radiation, respond by vibrating, creating heat. If enough heat is conducted, tumor cells near the tubes begin to shrink and die.

Using a mouse model, researchers injected kidney tumors with different quantities of MWCNTs and exposed the area to a three-watt laser for 30 seconds.

Researchers found that the mice who received no treatment for their tumors died about 30 days into the study. Mice who received the nanotubes alone or laser treatment alone survived for a similar length of time. However, in the mice who received the MWCNTs followed by a 30-second laser treatment, researchers found that the higher the quantity of nanotubes injected, the longer the mice lived and the less tumor regrowth was seen. In fact, in the group that received the highest dose of MWCNTs, tumors completely disappeared in 80 percent of the mice. Many of those mice continued to live tumor-free through the completion of the study, which was about nine months later.

"You can actually watch the tumors shrinking until, one day, they are gone," Torti said. "Not only did the mice survive, but they maintained their weight, didn't have any noticeable behavioral abnormalities and experienced no obvious problems with internal tissues. As far as we can tell, other than a transient burn on the skin that didn't seem to affect the animals and eventually went away, there were no real downsides - that's very encouraging."

Current thermal ablation, or heat therapy, treatments for human tumors include radiofrequency ablation, which applies a single-point source of heat to the tumor rather than evenly heating the tumor throughout, like the MWCNTs were able to. In addition to the 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 at other institutions.

"MWCNTs are more effective at producing heat than other investigational nanomaterials," Torti said. "Because this is a heat therapy rather than a biological therapy, the treatment works on all tumor types if you get them hot enough. We are hopeful that we will be able to translate this into humans."

Before the treatment can be tested in humans, however, 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, looking at things such as what happens to the nanotubes, which are synthetic materials, over time.

The treatment would need to be tested in larger animals before being tested in human trials, as well. Conceptually, however, Torti said there is no barrier to applying the therapy into humans to treat tumors close to the surface of the skin, such as in the oral cavity and bladder wall.

"We're excited about this," Torti said. "This is the intersection between the physical and the medical sciences that represents the new frontier in modern medicine."

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

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