Researchers Using Nanoscale Particles to Battle Cancer

June 28 2010

(PhysOrg.com) -- Forget surgery. One team of Kansas State University researchers is exploring nanoparticle-induced hyperthermia in the battle against cancer.

Since 2007 the team of Deryl Troyer, professor of anatomy and physiology; Viktor Chikan, assistant professor of chemistry; Stefan Bossmann, professor of chemistry; Olga Koper, adjunct professor of chemistry at K-State and vice president of technology and chief technology officer for NanoScale Corporation; and Franklin Kroh, senior scientist at NanoScale Corporation, has been using iron-iron oxide nanoparticles to overheat or bore holes through cancerous tissue to kill it. The nanoparticles are coupled with a diagnostic dye. When the dye is released from the nanoparticle's electronic sphere, it coats other cancerous tissues within the body, making cancer masses easier for medical professionals to detect.

The team is partnered with NanoScale Corporation, a Manhattan company that develops and commercializes advanced materials, products and applications.

Their research, which was explored in mouse models, is currently being reviewed for pre-clinical trials. If accepted, Bossmann said he's optimistic about what it could mean for people with cancer.

"It means within the next decade there is a chance to have an inexpensive cancer treatment with a higher probability of success than chemotherapy," he said. "We have so many drug systems that are outrageously expensive. The typical cancer patient has a million dollars in costs just from the drugs, and this method can be done for about a tenth of the cost.

"Also, our methods are physical methods; cancer cells cannot develop a resistance against physical methods," Bossmann said. "Cancer cells can develop resistance against chemotherapeutics, but they cannot against just being heated to death or having a hole made in them."

While overheating or boring into cancerous cells may sound extreme, the nanoparticles act with orchestrated precision once ingested by the cancer cells, Bossmann said.

Getting the nanoparticles into the cancerous tissue is a lot like fishing, he said.

"We have our fishing pole with the nanoparticles as a very attractive bait that the cancer wants to gobble up -- like a worm is for a fish," he said.

In this case, the bait is a layer of organic material that attracts the cancer to the nanoparticles. The cancer wants the coating for its metabolism. In addition to serving as bait, the organic layer also serves as a cloaking mechanism from the body's defenses, which would otherwise destroy the foreign objects.

Once inside, the nanoparticles -- made with a metal iron core and layered with iron oxide and an organic coating -- go to work. An alternating magnetic field causes the particles to produce friction heat, which is transferred to the cancer cells' surrounding proteins, lipids and water, creating little hotspots. With enough hotspots the tumor cells are heated to death, preserving the healthy tissue, Bossmann said. If the hotspots are not concentrated, the heat destroys the cell's proteins or lipid structures, dissolving the cell membrane. This creates a hole in the tumor and essentially stresses it to death.

"A little stress can push a tumor over the edge," Bossmann said.

The dye within each nanoparticle's electronic sphere is then severed by enzymes and used to check for cancerous masses within the body.

"In the future, someone might be able to develop a blood test because part of these enzymes escape into the bloodsteam. In five years or so, we may be able to draw a blood sample from the patient to see if the patient has cancer, and from the distribution of cancer-related enzymes, what cancer they most likely have," Bossmann said.

While the team has tested the platform only on melanoma and on pancreatic and breast cancer, Bossmann said their technique can be applied to any type of cancer.

The team filed a patent in 2008.

Provided by Kansas State University