Gold nanorods attach to, kill bladder cancer cells

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(Phys.org) —A major strategy of modern cancer research is to discover a difference between cancerous and healthy cells and then to specifically target this difference to kill cancer cells without harming healthy tissue. A University of Colorado Cancer Center study presented today at the American Association for Cancer Research (AACR) Annual Meeting 2014 demonstrates a novel strategy that accomplishes both: bladder cancer cells overexpress the protein EGFR; gold nanorods can be engineered to attach to EGFR proteins; and then the application of low-

intensity laser to the tissue can preferentially heat these gold nanorods, killing the EGFR-rich cancer cells to which they are attached.

"I know this sounds futuristic, but the concept is fairly straightforward: EGFR makes bladder cancer cells different from the surrounding healthy tissue and our strategy uses nanotechnology to kill only these cells," says Thomas Flaig, MD, medical director of the University of Colorado Cancer Center's Clinical Investigations Shared Resource and associate professor of medicine at the University of Colorado School of Medicine.

Flaig and co-primary-investigator Won Park, PhD, CU Cancer Center investigator and associate professor in the CU Boulder Department of Electrical, Computer and Energy Engineering, are quick to point out the difference between their technique and existing drugs like gefitinib and erlotinib that target EGFR-dependent cancers.

"These early-stage bladder cancers aren't necessarily addicted to EGFR – they don't need it to survive or grow like many EGFR-dependent cancers and so using a drug to cut off this supply of EGFR doesn't do much good. However, the overexpression of EGFR marks these cells. Our approach depends only on recognizing and exploiting this marker," Flaig says.

The researchers accomplish this second task of "exploiting" the EGFR marker of early-stage bladder cancer cells by injecting a treatment suspension into the bladder that contains tiny gold nanorods. To these gold nanorods, each only about 50nm long, the group attaches antibodies that in turn attach to EGFR proteins. Thus, gold nanorods become hooked to EGFR proteins on the surface of the bladder cancer cells.

The gold nanorods alone are harmless. But at that point, the researchers apply a weak, nontoxic laser to the tissue – however, the laser is tuned to

a specific frequency designed to excite these nanorods. Like the fabled soprano's ability to break a wine glass with her voice, the frequency of the laser creates vibration and eventually enough heat to kill the cancer cells to which the nanorods are attached. Again: nanorods with EGFR antibodies attach to EGFR, which coat bladder cancer cells. Weak laser heats the nanorods, killing the cells.

In a study of 16 mice treated with the procedure, 13 showed markers consistent with disease reduction, compared with only 2 of 14 mice treated with the sham of weak laser alone. None of the treated mice showed disease progression; Seven of the 14 untreated mice progressed.

"It's not as far from human application as it might seem," Flaig says. "We already treat bladder cancer patients with liquid-based drugs introduced into the bladder, and then patients are scoped regularly. You can see the pathway into clinical use. Instead of or in addition to drugs commonly in use, we could introduce engineered nanoparticles, and then the scope could easily transmit laser."

Provided by University of Colorado at Boulder