Targeted Nanoparticles Destroy Prostate Tumors

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Biodegradable polymer nanoparticles, linked to a protein-binding nucleic acid known as an aptamer and loaded with the anticancer agent docetaxel, can target and kill prostate tumors growing in mice. Using this targeted nanoparticle to deliver docetaxel appears to reduce the toxic side effects associated with this drug.

Writing in the journal *Proceedings of the National Academy of Sciences*, a team of researchers led by Omid Farokhzad, M.D., of the Harvard Medical School, and Robert Langer, Ph.D., of the Massachusetts Institute of Technology, reported on its work developing custom nanoparticles that can home in on malignant cells and then enter the cells to deliver lethal doses of chemotherapy. Langer is co-principal investigator of the MIT-Harvard Center of Cancer Nanotechnology Excellence (CCNE) and Farokhzad is a project leader with the MIT-Harvard CCNE.

The team conducted experiments first on cultured tumor cells and then on mice bearing human prostate tumors, both with success. In the experiments with mice, the tumors shrank dramatically, and all of the treated mice survived the study. In contrast, only 57 percent of the animals treated with an untargeted nanoparticle survived for the duration of the study, and only 14 percent of the animals treated with docetaxel alone survived. "A single injection of our nanoparticles completely eradicated the tumors in five of the seven treated animals, and the remaining animals also had significant tumor reduction, compared to the controls," said Farokhzad.

In the study, Farokhzad, Langer and colleagues tailor-made tiny sponge-like nanoparticles laced with the drug docetaxel. The particles are specifically designed to dissolve in a cell's internal fluids, releasing the anticancer drug either rapidly or slowly, depending on what is needed to kill a particular type of tumor. These nanoparticles were purposely made from materials that are familiar and approved for medical applications by the U.S. Food and Drug Administration.

Also, to make sure only the malignant cells receive chemotherapy, the nanoparticles are "decorated" on the outside with targeting molecules called aptamers, small pieces of RNA that are designed to bind tightly to specific proteins, much as protein-based antibodies do. Like homing devices, the aptamers specifically recognize the surface molecules on cancer cells, while avoiding normal cells. In this case, the researchers used an aptamer that binds to prostate-specific membrane antigen, a well-characterized protein found on the surface of prostate cancer cells.

This work, which was funded in part by the National Cancer Institute, is detailed in a paper titled, “Targeted nanoparticle-aptamer bioconjugates for cancer chemotherapy *in vivo*.” An investigator from the Gwangju Institute of Science and Technology in Korea also participated in this study. An abstract of this paper is available through PubMed.

Source: National Cancer Institute