Nanoparticles deliver combination chemotherapy directly to prostate cancer cells

October 27 2010

In recent years, studies have shown that for many types of cancer, combination drug therapy is more effective than single drugs. However, it is usually difficult to get the right amount of each drug to the tumor. Now, researchers at the Massachusetts Institute of Technology (MIT) and Brigham and Women's Hospital have developed a nanoparticle that can deliver precise doses of two or more drugs to prostate cancer cells. Such particles, say the researchers, could improve the effectiveness of chemotherapy while minimizing the side effects normally seen with these drugs.

In a study appearing in the Proceedings of the National Academy of Sciences, a team of investigators led by Omid Farokhzad and Robert Langer, both members of the MIT-Harvard Center for Cancer Nanotechnology Excellence, demonstrated the utility of their new particle by using it to deliver cisplatin and docetaxel, two drugs commonly used to treat many different types of cancer.

To build their nanoparticles, the researchers developed a new strategy that allowed them to incorporate drugs with very different physical properties, which had been impossible with previous drug-delivering nanoparticles. In earlier generations of nanoparticles, drug molecules were encapsulated in a polymer coating. Using those particles, hydrophobic (water-repelling) drugs, such as docetaxel, and hydrophilic (water-attracting) drugs, such as cisplatin, can't be carried together, nor can drugs with different charges. "With the old way, you can only do it if the two drugs are physically and chemically similar," said Dr. Farokhzad.

"With this way, you can put in drugs that are relatively different from each other."

With the researchers' new technique, called "drug-polymer blending," drug molecules are hung like pendants from individual units of the polymer before the units are assembled into a polymer nanoparticle. This approach allows the researchers to precisely control the ratio of drugs loaded into the particle and to control the rate at which each drug will be released once it enters a tumor cell.

For this study, once the investigators loaded the drugs into the nanoparticle, the researchers added a tag that binds to a molecule called PSMA that is located on the surfaces of most prostate tumor cells. This tag allows the nanoparticles to go directly to their target, bypassing healthy tissues and potentially reducing the side effects caused by most chemotherapy drugs.

The researchers have filed for a patent on the polymer-blending fabrication technique and are now testing the drug-delivering particles in animals. Once they gather enough animal data, which could take a few years, they hope to begin clinical trials.

More information: This work, is detailed in a paper titled, "Engineering of self-assembled nanoparticle platform for precisely controlled combination drug therapy," doi:10.1073/pnas.1011368107 .

Provided by National Cancer Institute