Nanodiamonds Advance Anticancer Gene Therapy

September 25 2009

(PhysOrg.com) -- Gene therapy holds promise in the treatment of cancer as well as a large number of other diseases. However, developing a scalable system for delivering genes to cells both efficiently and safely has been challenging. Now, two teams of researchers have developed versatile nanotechnology-enabled platforms that could get therapeutic genes safely and efficiently into cancer cells.

In one study, a team of Northwestern University researchers has shown that nanodiamonds can serve as a novel gene delivery technology that combines key enhanced delivery efficiency along with outstanding biocompatibility, all in one drug delivery package. “Finding a more efficient and biocompatible method for gene delivery than is currently available is a major challenge in medicine,” said Dean Ho, Ph.D., who led the research. “By harnessing the innate advantages of nanodiamonds, we now have demonstrated their promise for gene therapy.”

Dr. Ho and his research team engineered surface-modified nanodiamond particles that successfully and efficiently delivered DNA into mammalian cells. The delivery efficiency was 70 times greater than that of a conventional standard for gene delivery. The results of these experiments were published in the journal *ACS Nano*. Dr. Ho and his research team originally demonstrated the application of nanodiamonds for chemotherapeutic delivery (click here for an earlier story).

Multiple barriers confront conventional approaches, making it difficult to integrate both high-efficiency delivery and biocompatibility into one

gene delivery system. But the Northwestern researchers were able to do just that by functionalizing the nanodiamond surface with a low-molecular-weight polymer known as PEI800. PEI800 is currently used in gene therapy clinical trials, and although it is biocompatible, it does not deliver DNA to cells with high efficiency. The combination of PEI800 and nanodiamonds produced a 70-fold enhancement in delivery efficiency over PEI800 alone, and the biocompatibility of PEI800 was preserved. The process is highly scalable, which holds promise for translational capability.

The researchers used a human cervical cancer cell line called HeLa to test the efficiency of gene delivery using the functionalized nanodiamonds. Glowing green cells confirmed the delivery and insertion into the cells of a DNA sequence that codes for green fluorescent protein. This experiment served as a demonstrative model of how specific disease-fighting DNA strands could be delivered to cells.

This work is detailed in the paper "Polymer-functionalized nanodiamond platforms as vehicles for gene delivery." An investigator from Shinshu University in Japan also participated in this study. An abstract of this paper is available at the journal's Web site.

Provided by National Cancer Institute (news : web)