Glowing Cornell dots -- a potential cancer diagnostic tool set for human trials

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The U.S. Food and Drug Administration (FDA) has approved the first clinical trial in humans of a new technology: Cornell Dots, brightly glowing nanoparticles that can light up cancer cells in PET-optical imaging.

A paper describing this new medical technology, "Multimodal silica nanoparticles are effective cancer-targeted probes in a model of human melanoma," will be published June 13, 2011 in the Journal of Clinical Investigation (July 2011). This is a collaboration between Memorial Sloan-Kettering Cancer Center (MSKCC), Cornell University, and Hybrid Silica Technologies, a Cornell business start-up.

For the first time, scientists report a uniquely advanced and comprehensive characterization of Cornell Dots - an ultra small, cancer-targeted, multimodal silica nanoparticle - which has recently been approved as an "investigational new drug" (IND) by the FDA for a first-in-human clinical trial, says Michelle S. Bradbury, M.D., of the Memorial Sloan-Kettering Cancer Center and an assistant professor of radiology at Weill Cornell Medical College.

Cornell Dots are silica spheres less than 8 nanometers in diameter that enclose several dye molecules. The silica shell, essentially glass, is chemically inert and small enough to pass through the body and out in the urine. For clinical applications, the dots are coated with polyethylene glycol (PEG) so the body will not recognize them as foreign substances.

A guiding light within the body: To make the dots stick to tumor cells, organic molecules that bind to tumor surfaces or even specific locations within tumors can be attached to the PEG shell. When exposed to near-infrared light, the dots fluoresce much brighter than dye to serve as a beacon to identify the target cells. The technology, the researchers say, enables visualization during surgical treatment, showing invasive or metastatic spread to lymph nodes and distant organs, and can show the extent of treatment response.

Hooisweng Ow, a coauthor of the paper and once a graduate student working with Ulrich Wiesner, Cornell Professor of Materials Science and Engineering, developed first-generation Cornell dots in 2005. Together, Wiesner, Ow and Kenneth Wang, have co-founded the company Hybrid Silica Technologies (HST) to commercialize the invention. The combined team of MSKCC, Cornell and HST researchers is now in the process of forming a new commercial entity in New York City that will help transition the research into commercial products that will benefit cancer patient care.

"This is the first FDA IND approved inorganic particle platform of its class and properties that can be used for multiple clinical indications, two of which are explored: cancer targeting for diagnostics and future therapeutic diagnostics, as well as cancer disease staging and tumor burden assessment via lymph node mapping," says Bradbury.

The Cornell Dots were optimized for efficient renal clearance, allowing the body to pass them through the kidneys.

In addition, the scientists were able to perform real-time imaging of lymphatic drainage patterns and particle clearance rates, as well as sensitively detect nodal metastases. Nodal mapping is now being pursued under a new award of a BioAccelerate NYC Prize from the Partnership for New York City and the New York City Economic Development Corporation, which is expected to lead to another clinical trial in humans.

The lead authors of the paper are Miriam Benezra and Oula Penate-Medina, who are researchers at MSKCC. Bradbury and Wiesner are the senior authors.

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