Nanotechnology identifies brain tumor types through MRI 'virtual biopsy' in animal studies

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Biomedical researchers at Cedars-Sinai have invented a tiny drug-delivery system that can identify cancer cell types in the brain through ?virtual biopsies? and then attack the molecular structure of the disease.

If laboratory research with mice is borne out in human studies, the results could be used to deliver nano-scale drugs that can distinguish and fight tumor cells in the brain without resorting to surgery.

?This nanodrug can be engineered to carry a variety of drugs, proteins and genetic materials to attack tumors on several fronts from within the brain,? says Julia Ljubimova, MD, PhD, professor of neurosurgery and biomedical sciences at Cedars-Sinai and a lead author of an article published online in the American Chemical Society?s journal *ACS Nano*.

Ljubimova, director of the Nanomedicine Research Center in the Department of Neurosurgery and director of the Nanomedicine Program at the Samuel Oschin Comprehensive Cancer Institute, has received a $2.5 million grant from the National Institutes of Health to continue the research.

The drug delivery system and its component parts, together called a nanobioconjugate or nanodrug, is in an emerging class of molecular drugs designed to slow or stop cancers by blocking them in multiple

ways within the brain. The drug is about 20 to 30 nanometers in size, ? a fraction of the width of a human hair, which is 80,000 to 100,000 nanometers wide.

Cedars-Sinai scientists began developing the ?platform? of the drug delivery system about a decade ago. The nanodrug can have a variety of chemical and biological ?modules? attached.

Each component serves a specialized function, such as seeking out cancer cells and binding to them, permeating the walls of blood vessels andtumor cells, or dismantling molecular mechanisms that promote tumor growth,? says Eggehard Holler, PhD, professor of neurosurgery and director of nanodrug synthesis at Cedars-Sinai.

The new delivery system plays two roles: diagnosing brain tumors by identifying cells that have spread to the brain from other organs, and then fighting the cancer with precise, individualized tumor treatment.

Researchers can determine tumor type by attaching a tracer visible on an MRI. If the tracer accumulates in the tumor, it will be visible on MRI. With the cancer?'s molecular makeup identified through this virtual biopsy, researches can load the ?delivery system? with cancer-targeting components that specifically attack the molecular structure.

To show that the virtual biopsies can distinguish one cancer cell type from another, the researchers devised what is believed to be a unique method, implanting different kinds of breast and lung cancers into laboratory mice to represent metastatic disease ?with one type of cancer implanted on each side of the brain. Lung and breast cancers are those that most often spread to the brain.

The researchers used the nano delivery system to identify and attack the cancers. In each instance, animals that received treatment lived

significantly longer than those in control groups.

Several drugs are quite effective in treating different types of breast cancers, lung cancer, lymphoma and other cancers at their original sites, but they are ineffective against cancers that spread to the brain because they cannot cross the blood-brain barrier that protects the brain from toxins in the blood, says Keith Black, MD, chair of the Department of Neurosurgery, director of the Maxine Dunitz Neurosurgical Institute, director of the Johnnie L. Cochran, Jr., Brain Tumor Center and the Ruth and Lawrence Harvey Chair in Neuroscience.

The nanodrug is engineered to cross this barrier with its payload intact, so drugs that are effective outside the brain may be effective inside as well, Black added.

More information: "MRI Virtual Biopsy and Treatment of Brain Metastatic Tumors with Targeted Nanobioconjugates." Publication Date (Web): April 23, 2015. DOI: 10.1021/acsnano.5b01872

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