Fullerenes Yield Stable, Powerful MR Imaging Agent

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Fullerenes, the soccer ball-shaped spheres of carbon that helped usher in the nanotechnology era, have been touted as versatile containers for delivering drugs and other clinically useful molecules to tumors. Turning promise into reality, investigators from the National Cancer Institute's Cancer Nanotechnology Platform Partnership at Virginia Commonwealth University have developed a new imaging agent that is 40 times more potent at boosting magnetic resonance imaging (MRI) signals than agents currently approved for human clinical use.

Reporting its work in the journal Radiology, a team headed by Panos Fatouros, Ph.D., and Harry Dorn, Ph.D., has shown that C 80 fullerenes – spheres made of 80 carbon atoms – can act as stable cages for gadolinium ions, the key component of MRI contrast agents. Gadolinium can be toxic, so creating a stable platform for its delivery in the body is critical. Equally as important, the manner in which gadolinium sits within the fullerene provides a more optimal physical environment in which gadolinium can interact with a magnetic field, thereby boosting signal enhancement. The researchers also described methods they used to render the gadolinium-containing fullerenes soluble in water.

In vitro experiments demonstrated that their gadolinium-loaded fullerene not only boosted MRI signals but had the interesting property of providing a bigger signal enhancement at low concentrations. Subsequent in vivo studies imaging brain tumors in experimental animals also found that this agent was better at delineating tumors at low concentrations than it was at high concentrations. These latter experiments also showed

that the fullerene-based imaging agent remained in tumors far longer than did a conventional gadolinium contrast agent, and as a result was better able to discern the margins of growing tumors.

The researchers note that the methods they used to create their gadolinium agent will also produce fullerenes loaded with other clinically useful metals, such as lutetium, terbium or holmium. A combined gadolinium-terbium fullerene, for example, could image a tumor and deliver a lethal dose of radioactivity to a tumor simultaneously. The investigators also comment that since the metal atoms are loaded stably inside the fullerene particle it is likely that the pharmacological properties of different formulations would not change, an advantage that could speed clinical development of a family of agents based on the same fullerene.

This work, which was supported by the NCI, is detailed in a paper titled, "In vitro and in vivo imaging studies of a new endohedral metallofullerene nanoparticle." Investigators from Virginia Polytechnic Institute and State University and Emory and Henry College also participated in this study. This paper was published online in advance of print publication. An abstract of this paper is available at the journal's website.

Source: National Cancer Institute