Nanotubes Enable New Approach to Cancer Radiotherapy

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Radioactive elements, or radionuclides, are well-established anticancer agents whose main limitation is that they kill healthy cells almost as easily as they do tumors. But because nanoparticles can be targeted to tumors, researchers have seized on the idea of using nanoparticles to deliver radionuclides to tumors, thus sparing healthy tissues from radiation-induced damage.

In an important step toward realizing the potential of radionuclide-loaded nanoparticles as radiotherapeutic agents, Lon Wilson, Ph.D., and colleagues at Rice University have demonstrated that ultrashort carbon nanotubes will permanently entrap the potent alpha particle emitting element astatine-211 ($_{211}$At), which has a half-life of 7.2 hours.

Reporting its work in the journal *Small*, Wilson and his colleagues chose ultrashort carbon nanotubes, which are 20 to 50 nanometers in length and approximately 1 nanometer in diameter, because of several important physical characteristics that lend them to use in cancer applications. Their carbon surface is easily modified to render the nanotubes biocompatible, provide attachment sites for targeting agents, and prevent the nanotubes from sticking to one another. Ultrashort carbon nanotubes also penetrate the cell wall readily and rapidly accumulate inside cells.

In addition, molecules encapsulated in ultrashort carbon nanotubes tend to stay there—previous work with iodine ions showed that retention half-life was approximately 2 years. Indeed, tests with $_{211}$At-loaded nanotubes

exposed to human serum and physiological conditions showed that the nanotubes retained more than 93 percent of their radioactive load. The investigators are now working to develop $_{211}$At-loaded ultrashort carbon nanotubes linked to tumor-targeting agents.

This work, supported in part by the NCI, is detailed in the paper "(211)AtCl@US-tube nanocapsules: a new concept in radiotherapeutic-agent design." This paper was published online in advance of print publication. An abstract of this paper is available through PubMed.

Source: National Cancer Institute