GADOLINIUM NEUTRON CAPTURE THERAPY

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Gadolinium Neutron Capture Therapy (GdNCT) for brain cancer was first suggested in the 1980’s, but its development was impeded by the lack of evidence that Gd compounds could target the nuclei of cancer cells, which is the main requirement for the success of this therapy.

We recently demonstrated that one Gd compound (Gd-DTPA) preferentially targets 84\% of the nuclei of cancer cells in culture [1]. We now extended the study to a new Gd compound, specifically designed to target cell nuclei and bind to DNA. The new compound, engineered by our group, is called HM-Gd-DOTA, and complexes Gd-DOTA, a well known MR imaging agent that highlights tumors, and Hoechst, a DNA minor groove binder used in biology to fluorescently label the nuclei of all cells. The experiments were performed at the UW-SRC on the HERMON beamline, with the SPHINX (Spectromicroscope for Photoelectron Imaging of Nanostructures with X-rays) instrument. The cells were first examined for phosphorous to identify P-rich cell nuclei and then for Gd. We observed that Gd-DOTA alone targets only 56\% of the cancer cell nuclei, which is not enough for effective therapy. Our most recent spectromicroscopy data prove that 100\% of the nuclei are reached by Gd when the cells are exposed to HM-Gd-DOTA. These results were confirmed on two different glioblastoma cell lines: TB1) and MO59K. HM-Gd-DOTA, therefore, is a potential agent for neutron capture therapy. In vivo experiments and toxicity studies for this new compound must be performed before its real efficacy can be established.