Nanoparticle shows promise in reducing radiation side effects

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With the help of tiny, transparent zebrafish embryos, researchers at the Kimmel Cancer Center at Thomas Jefferson University and Jefferson Medical College are hoping to prove that a microscopic nanoparticle can be part of a "new class of radioprotective agents" that help protect normal tissue from radiation damage just as well as standard drugs.

Reporting November 7, 2006 at the annual meeting of the American Society for Therapeutic Radiology and Oncology in Philadelphia, they show that the nanoparticle, DF-1 – a soccer ball-shaped, hollow, carbon-based structure known as a fullerene – is as good as two other antioxidant drugs and the FDA-approved drug, Amifostine in fending off radiation damage from normal tissue.

The scientists, led by Adam Dicker, M.D., Ph.D., professor of radiation oncology at Jefferson Medical College of Thomas Jefferson University in Philadelphia and at Jefferson's Kimmel Cancer Center, and Ulrich Rodeck, M.D., professor of dermatology at Jefferson Medical College, compared DF-1 to two superoxidase dismutase (SOD) mimetics, which are antioxidant drugs. They exposed zebrafish embryos to radiation with either DF-1, a SOD or Amifostine. DF-1 and the SODs markedly reduced radiation damage and increased overall survival and was comparable to the protection provided by the Amifostine.

Dr. Dicker explains that one way that radiation frequently damages cells and tissues is by producing "reactive oxygen species" – oxygen radicals, peroxides and hydroxyls. The scientists showed that zebrafish embryos

exposed to ionizing radiation had more than 50 percent reduction in the production of reactive oxygen species compared to untreated embryos. DF-1 acts like an "oxygen sink," binding to dangerous oxygen radicals.

"We use the model to show that not only does it protect and improve the overall survival of these zebrafish embryos, but it can also protect from the toxic effects of radiation on particular organ systems, such as the kidney and central nervous system," Dr. Dicker says.

Zebrafish embryos are transparent for the first month of life and allow scientists to closely observe organ damage produced by cancer treatments. Zebrafish have most of their organs formed by the third day after fertilization.

While chemotherapy and radiotherapy are the standard treatments for cancer, they take their respective toll on the body. Radiation can damage epithelial cells and lead to permanent hair loss, among other effects, and certain types of systemic chemotherapy can produce hearing loss and damage to a number of organs, including the heart and kidneys. Some other side effects include esophagitis, diarrhea, and mouth and intestinal ulcers.

Only Amifostine has been approved to date by the federal Food and Drug Administration, to help protect normal tissue from the side effects of chemotherapy and radiation, and researchers would like to develop new and improved agents.

Source: Thomas Jefferson University