Novel Nanoparticles Prevent Radiation Damage During Cancer Therapy

27 May 2010

(PhysOrg.com) -- Nanoparticles covered with the natural pigment melanin may protect bone marrow from the harmful effects of anticancer radiation therapy, according to scientists at Albert Einstein College of Medicine of Yeshiva University who successfully tested the strategy in mouse models. The results of this research, which was directed by Ekaterina Dadachova, were published in the *International Journal of Radiation Oncology, Biology and Physics*.

Radiation therapy is used to kill cancer cells and shrink tumors. But because radiation also damages normal cells, doctors must limit the dose. Melanin, the naturally occurring pigment that gives skin and hair its color, helps shield the skin from the damaging effects of sunlight and has been shown to protect against radiation. In fact, previous research by Dr. Dadachova and colleagues showed that melanin protects against radiation by helping prevent the formation of free radicals, which cause DNA damage, and by scavenging the free radicals that do form.

To deliver melanin to the bone marrow, the researchers decided to use nanoparticles. “We wanted to devise a way to provide protective melanin to the bone marrow,” said Dr. Dadachova. “That’s where blood is formed, and the bone-marrow stem cells that produce blood cells are extremely susceptible to the damaging effects of radiation.” She and her colleagues created melanin nanoparticles by coating 20 nanometers silica particles with several layers of melanin pigment that they synthesized in their laboratory.

The researchers found that these particles successfully lodged in bone marrow after being injected into mice. Then, in a series of experiments, they investigated whether their nanoparticles would protect the bone marrow of mice treated with two types of radiation.

In the first experiment, one group of mice was injected with nanoparticles and a second group was not. Three hours later, both groups were exposed to whole-body radiation. For the next 30 days, the researchers monitored the blood of the mice, looking for signs of bone marrow damage such as decreased numbers of white blood cells and platelets. Compared with the control group, those receiving melanin nanoparticles before radiation exposure fared much better; their levels of white cells and platelets dropped much less precipitously. Ten days after irradiation, for example, platelet levels had fallen by only 10 percent in mice that had received nanoparticles compared with a 60 percent decline in untreated mice. Furthermore, levels of white blood cells and platelets returned to normal much more quickly than in the control mice.

A second experiment assessed not only bone-marrow protection but whether the nanoparticles might have the undesirable effect of infiltrating and protecting tumors being targeted with radiation. Two groups of mice were injected with melanoma cells that formed melanoma tumors. After one group of mice was injected with melanin nanoparticles, both groups received an experimental radiation treatment designed by Dr. Dadachova and her colleagues specifically for treating melanoma.

This treatment uses a radiation-emitting isotope “piggybacked” onto an antibody that binds to melanin. When injected into the bloodstream, the antibodies latch onto the free melanin particles released by cells within melanoma tumors. Their isotopes then emit radiation that kills nearby melanoma tumor cells.

Following the second experiment, the melanoma tumors shrank significantly and to the same extent in both groups of mice - indicating that the melanized nanoparticles did not interfere with the radiation therapy’s effectiveness. And once again, the melanized nanoparticles prevented radiation-induced bone-marrow damage: between the third and seventh day after the antibody-isotope radiation therapy was administered, mice injected with nanoparticles experienced a drop in white cells that was significantly less than occurred in mice not pre-treated with nanoparticles.

This work is detailed in a paper titled, “Melanin-Covered Nanoparticles for Protection of Bone Marrow During Radiation Therapy of Cancer.” An abstract of this paper is available at the journal’s Web site.

Provided by National Cancer Institute

APA citation: Novel Nanoparticles Prevent Radiation Damage During Cancer Therapy (2010, May 27) retrieved 27 February 2021 from https://phys.org/news/2010-05-nanoparticles-cancer-therapy.html