Nano-based antiradiation drug

Balls of carbon atoms called buckyballs only a nanometer or billionth of a meter in diameter could serve as future antiradiation drugs to help protect against the side effects of cancer therapies or against dirty bombs, experts told UPI's Nano World.

Radiation therapy and chemotherapy are the standard treatments for cancer, but they each take a toll on the body. Radiation damages skin, mouth, throat and bowel cells and can lead to fatigue, nausea, diarrhea and permanent hair loss, while chemotherapy can produce hearing loss and damage a number of organs, including the heart and kidneys.

"Although there is a lot of excitement in cancer research about nanoparticles as novel targeted therapies against tumors, in general these therapies will be combined with conventional chemo or radiation therapies. So we were interested in finding ways to reduce the side effects of conventional cancer therapies used in conjunction with targeted therapies, perhaps by using nanoparticles," said radiation oncologist Adam Dicker at Thomas Jefferson University in Philadelphia. To date, the FDA has approved just one drug, amifostine, to help protect normal tissue from the side effects of radiation and chemotherapy.

One way that radiation therapy and chemotherapy frequently injures cells and tissues are by producing damaging "reactive oxygen species," such as free radicals, oxygen ions and peroxides. The researchers and their collaborators at Houston-based nanotechnology firm C Sixty speculated the electron clouds that surround buckyballs might "soak up these free radicals," Dicker said.

To investigate how well buckyballs protect against radiation, the scientists used zebrafish embryos, which are transparent, helping scientists to closely observe damage produced by radiation treatments against organs. Zebrafish usually have most of their organs formed by day three of life, allowing the researchers to quickly and inexpensively conduct their research.

The researchers found that buckyballs given before or immediately after exposure to X-rays reduced organ damage by one-half to two-thirds, which is as good as the level of protection amifostine provides.

In long-term studies in animals, C Sixty has not found buckyballs to be toxic, Dicker said. "If it's less toxic and it works as well as amifostine, that's great. Amifostine is pretty toxic stuff," said Ralph Weichselbaum, chairman of radiation oncology at the University of Chicago.

Moreover, while amifostine is relatively unstable, buckyballs appear very stable, "so you can stockpile them and not have to worry about them going bad," Dicker said.

Weichselbaum and Dicker cautioned further experiments are needed to test the drug's clinical efficacy and toxicity in animals and humans. The researchers presented their results at the International Conference on Molecular Targets and Cancer Therapeutics in Philadelphia in November.

Dicker noted C Sixty can coat the buckyballs with molecules that could allow the nanoparticles to target and protect specific organs and tissues from radiation. Certain radioactive isotopes have a predilection for certain organs -- strontium for bone, for instance, he explained. Moreover, if a cancer patient is receiving radiation therapy to a particular part of their body, "increasing the specificity of protection may have advantages," Dicker said.