MEDICAL

X-rays light up brain tumor cells – then selectively destroy them

By Paul McClure
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X-rays and light have been used to treat fatal brain tumors DALL-E

Using very low-dose X-rays to activate compounds that light up and generate cancer-killing free radicals stalled brain tumor growth and doubled survival time, according to a new study. Importantly, healthy cells were left unaffected.

X-rays are known to penetrate the body's deep tissues, which is why they're used to deliver cancer radiotherapy. Whereas radiotherapy uses X-ray beams to damage tumor cells' DNA, killing them, photodynamic therapy uses a different method to achieve the same result. The photons in laser beams are used to excite light-reactive molecules called photosensitizers that have been placed in tumors, causing them to produce cancer-killing free radicals.

Both treatment approaches have downsides. Radiotherapy can damage healthy cells near the tumor, leading to side effects like nausea and hair loss, and photodynamic therapy can't reach deep tumors. In a new study led by Nanyang Technological University, Singapore (NTU Singapore), researchers have used a combination of radio- and photodynamic therapies, known as radiodynamic therapy, to selectively target and destroy brain tumor cells.

The therapy relies on a novel compound called a 'molecular radio afterglow dynamic probe' or MRAP, comprised of biochemicals and iodine. Compounds normally used in radiodynamic therapy contain heavy metals, which can cause cell damage; MRAPs don't contain any heavy metals. They're injected directly into a tumor and activated by X-rays at a dosage far less than that used in existing radiotherapy. Importantly, they're only activated in the presence of the cathepsin B (CatB) enzyme, which is known to be upregulated in cancer cells and plays a role in tumor growth and progression. When activated, MRAPs produce a bright, near-infrared 'afterglow,' generating cancer-destroying free radicals.

The researchers tested the treatment on mouse models of brain cancer, specifically glioblastoma, a fast-growing tumor that, in humans, has one of the lowest survival rates of any cancer. Tumors injected with MRAPs were irradiated with an X-ray dosage equivalent to more than six times lower than is normally used. Following treatment, the tumors stopped growing, and the treated mice survived twice as long as the untreated ones. Moreover, the researchers found that the MRAPs didn't produce free radicals in healthy cells, therefore creating no side effects. There was also no sign of tissue damage or weight loss. The MRAP compounds were eventually excreted in the animals' urine and feces.

"We used very low dosages of X-rays and cancer-killing MRAPs," said Professor Pu Kanyi from NTU Singapore's School of Chemistry, Chemical Engineering and Biotechnology and the study's senior and co-corresponding author. "Also, the anti-cancer compounds were active only in the brain tumor and not healthy cells. So, we expect our treatment method to be safer and have fewer side effects than existing ones."

The researchers will continue evaluating the safety and efficacy of MRAPs in larger preclinical models before proceeding to human trials. They are also working on improving the MRAP's ability to target cancer cells and adding immune system-boosting abilities to help the body fight off cancer recurrence.

The study was published in the journal *Nature Materials*.

Source: NTU Singapore

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NO COMMENTS

Paul McClure

Before realizing his writing passion, Paul worked as an intensive care nurse and a criminal defense lawyer for many years. He has a keen interest in mental health and addiction, chronic illness, and medical technology. After graduating with a Bachelor of Arts in journalism and creative writing in 2022, Paul joined New Atlas in 2023. Before starting with New Atlas, Paul had written for several online publications in the areas of health and well-being, parenting, entertainment, and popular culture.